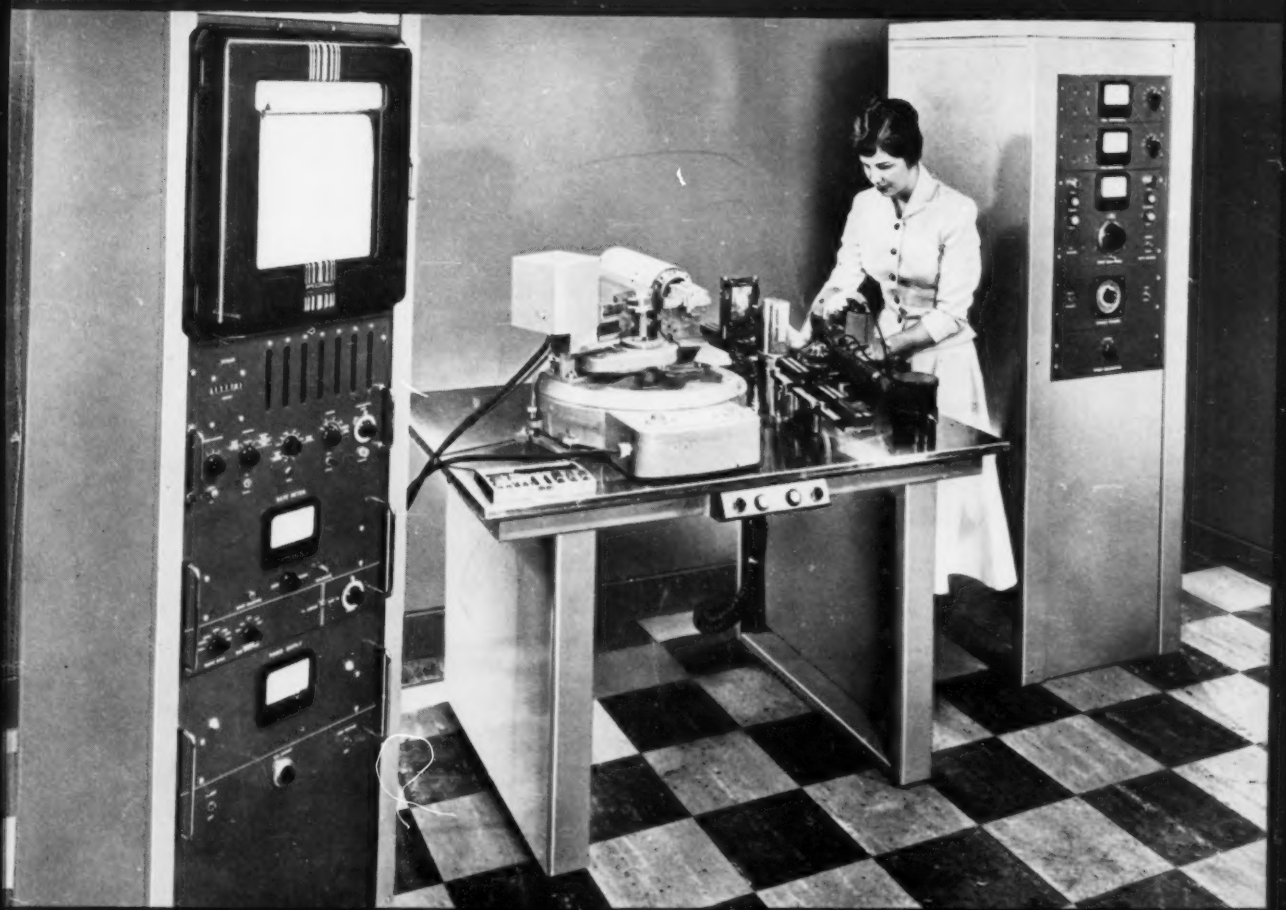
January-February 1950

METAL TREATING

Official Publication
METAL TREATING INSTITUTE

X-ray Diffraction Analysis helps solve complex industrial problems. Photo shows a General Electric diffraction unit. (See page 2)



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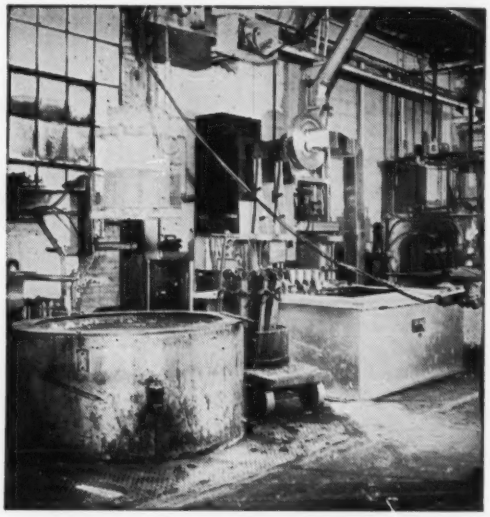

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Indexed in Engineering Index

EDITORIAL

X-rays and Heat Treating

Our cover picture and our lead feature article in this issue tie in with an important recent anniversary. It has been just a little over 60 years since Conrad Roentgen discovered X-rays and thereby shattered the complacency of the 19th century physicists who were smug in their belief that all great truths were then known. Roentgen's discovery ushered in an age of scientific progress which has continued down to the present day and which has opened up new vistas to radioactivity, nuclear physics, chemistry, electrons, cosmic rays, radio and television—and has made many important contributions to the techniques of heat treating.

X-rays are useful for industrial applications in a variety of ways. For diffraction,—when X-rays of proper characteristics and intensity strike a metal specimen they interact with the atoms to produce secondary rays. Angular positions and intensities of the secondary rays can be interpreted to reveal the crystal structures of metals and the identity of constituents. This, of course, is of basic importance to the metallurgist and heat treater. For radiography,—when X-rays of proper characteristics and intensity strike a specimen, they pass through to produce a negative picture on photographic film which shows density variations throughout the material. This technique is used as a means of inspection to detect flaws in castings or welds and the locations of internal parts. Finally, in crystallography,—X-rays are used to study grain structure and phase relationships as related to alloys and other materials. Here again the heat treater has found a useful tool for the study of raw materials and the results of treatment.

In this issue, Dr. Robert Ogilvie's article (page 2) explains some of the applications of X-rays to the heat treating industry, and our next issue will continue with some other material on this subject—all showing how the invention of the X-ray just sixty years ago has proved to be one of the world's great historic events by providing many solutions not only to man's vital problems of health but also to some difficult metallurgical and heat treating problems.

Herbert R. Herington

CONTENTS

Application of X-rays to the Heat Treating Industry
by Robert E. Ogilvie 2
Heat Treating Aircraft Fasteners
by Thomas A. Dickinson 6
Hardenability of Titanium Alloys 8
Ultrasonics for the Metal Treater
by John Starr 10
Right or Wrong in Labor Relations 14
Institute News 18
News to Heat Treaters 26
Apprentice Corner 33
Letters to the Editor 37
Manufacturers' Literature 38
Equipment & Materials Directory 39
Index to Advertisers 40

APPLICATION OF X-RAYS TO THE HEAT TREATING INDUSTRY

By **ROBERT E. OGILVIE**
Assistant Professor of Metallurgy
Massachusetts Institute of Technology, Cambridge, Mass.

THE RIGID requirements imposed by the consumer in the past few years have caused considerable interest in the application of x-rays to industrial problems. There also has been considerable technological advancement in x-ray equipment so that many complex problems are now a routine analysis.

The basic fundamentals of x-rays have a wide industrial application. The purpose of this article is to illustrate several x-ray techniques to a few existing industrial problems.

The x-ray techniques may be divided into two categories: 1. X-ray Fluorescent Analysis; and 2. X-ray Diffraction Analysis. From the x-ray fluorescent analysis it is possible to determine the elements present in a specimen and the diffraction analysis gives information in regard to the phases present in the specimen. Therefore, with the application of these two methods, considerable information may be obtained about the specimen.

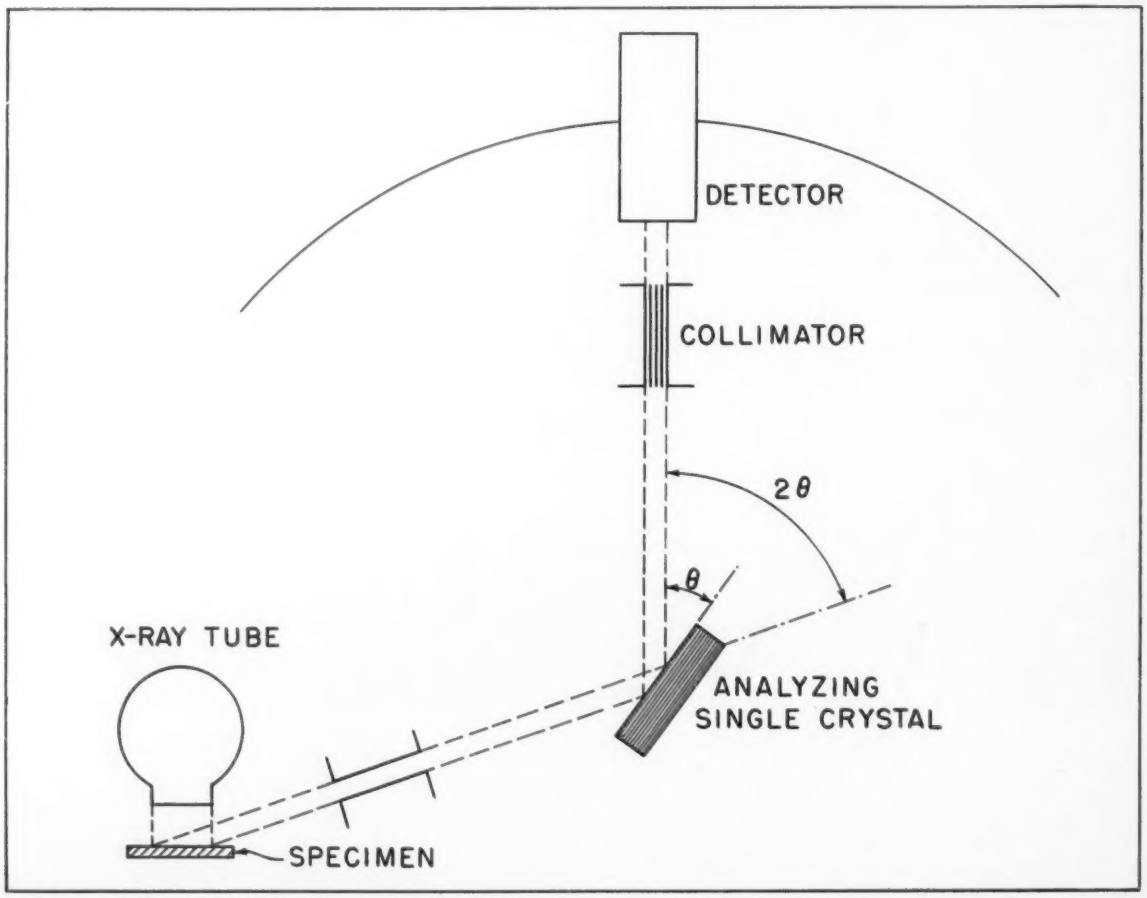


Figure 1—Schematic Sketch of a Fluorescent Analysis Unit.

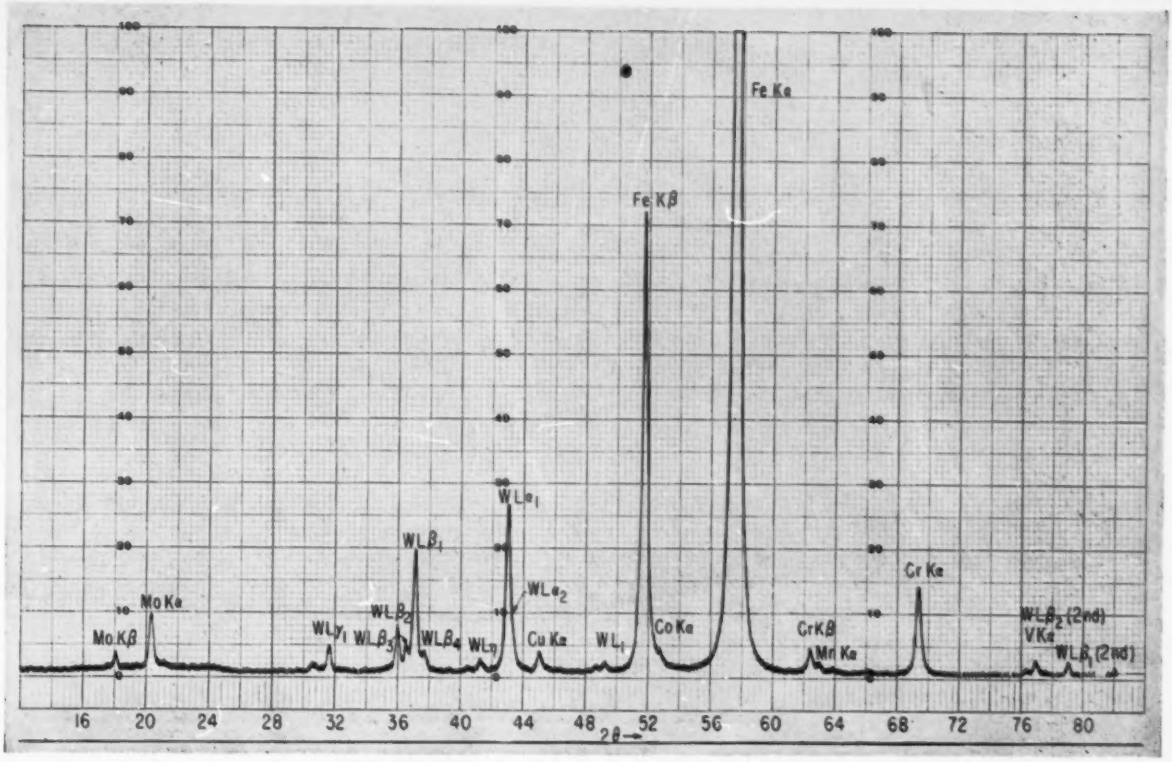


Figure 2—Fluorescent Pattern of an 18-4-1 Tool Steel.

X-ray Fluorescent Analysis

It is now possible, in special cases, to measure the fluorescent radiation of elements from atomic number 13 (aluminum) through the rest of the atomic table.

X-ray fluorescent analysis depends on the fact that elements in a specimen will emit their own characteristic radiation when the specimen is irradiated with particles (electrons) or x-rays of sufficient energy. The technique for analysis of x-ray fluorescence is unique because of the small number of lines in the spectrum and the method may be applied to elements present in large amounts. The emitted characteristic (secondary) radiation is measured by means of a spectrometer. The purpose of the spectrometer is to extract and measure the intensity of the radiation of a particular element from the polychromatic radiation emitted from the specimen. Figure 1 illustrates schematically the flat crystal reflection method for analyzing the secondary radiation. The analyzing crystal will diffract only the characteristic wavelength λ at the angle θ according to the usual Bragg equation, $n\lambda = 2d \sin \theta$, where n is the order of diffraction and d the interatomic spacing of the diffracting planes.

One of the most pressing problems that fabrication plants have today is the identification of various types

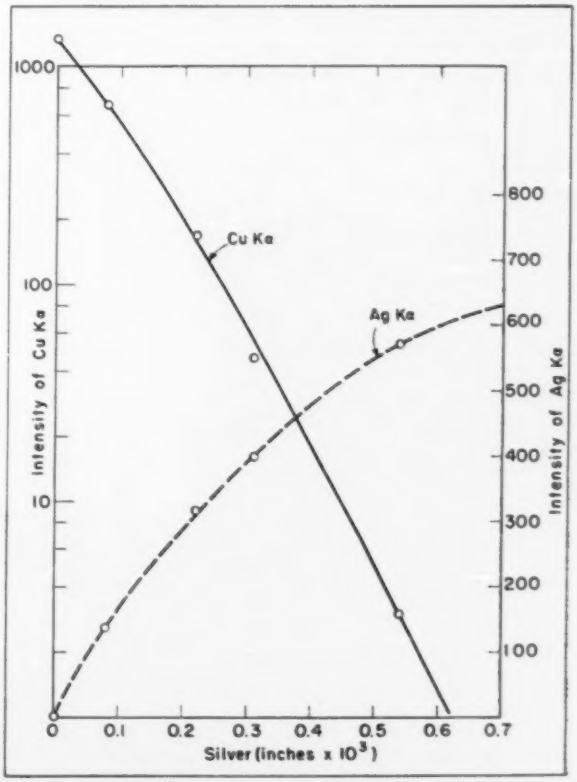


Figure 3—Calibration Curves for Silver Plating on Copper.

of alloys. With the application of the x-ray fluorescent method one is able not only to make a quantitative analysis of the alloy but also to make a quick classification. The method has had good success in classifying certain types of stainless steels. In particular to determine whether the stainless is stabilized with columbium or titanium or to check if molybdenum is present as one would expect in a 316 or 317 stainless. To make such a qualitative check requires but a few minutes, but to make a quantitative check requires the use of suitable standards. With a suitable calibration curve a quantitative determination would still require but a few minutes. Figure 2 shows a typical recording of an 18-4-1 tool steel. The position of the lines identify the elements present and the intensities are a function of the amount of the elements present.

Fluorescent analysis may be used on solids, liquids or powders and finds application in many unique problems. The determination of the plating or cladding thickness may be obtained simply by this technique. For example, Figure 3 illustrates how the characteristic copper radiation is attenuated by an increasing silver layer. The silver layer not only absorbs energy from the primary radiation, which is exciting the copper, but also absorbs the secondary copper radiation. This dual absorption makes it a very sensitive technique for determining the thickness of silver.

X-ray Diffraction Analysis

From the x-ray fluorescent analysis one is able to determine the elements present in the specimen. With the application of x-ray diffraction one can determine the nature and structure of the phases present in the specimen. The basis of x-ray diffraction analysis is that each phase will have its own characteristic diffraction pattern and this diffraction pattern acts as a set of finger prints.

The x-ray diffraction pattern differs from the fluorescent pattern in that each intensity maximum corresponds to the diffraction from a particular set of planes in a phase by monochromatic radiation. The fluorescent pattern on the other hand has maxima corresponding to different x-ray wavelengths. This merely says that according to Bragg's Law if we keep (d) a constant and vary λ, as in the fluorescent analysis, the angle θ of the maximum will depend upon the wavelengths. In the diffraction analysis λ is a constant and the random grains of the specimen will have crystallographic planes of different spacing (d) which will diffract at different angles of θ. Figure 4 shows two of the commercial diffraction units now available.

In a multiphase system each phase will diffract its own particular pattern. If there are many phases present the interpretation of the composite pattern becomes very difficult. This is especially so if the individual phases present are of a complex structure.

There are many cases of particular importance in the heat treating industry where x-ray diffraction can be used to a great advantage. The presence of retained austenite is a very important item in the case of dimensional stability and wear resistance in tool steels. The determination of retained austenite by metallographic means is usually quite difficult but it may be observed by x-rays when present as low as 1 percent. Figure 5 illustrates a diffraction pattern of an as quenched 18-4-1 tool steel with about 10 percent retained austenite and about 15 percent carbide. The diffraction lines are very broad because of the microstresses in the martensite.

One other very important feature of x-ray diffraction is that it is the only non-destructive method of measuring residual stresses. This is a very important consideration in the case of hardened gear teeth, bearing races and shot-peened materials. If there is a residual surface stress it will act to change the lattice spacing of the material. When the lattice spacing is changed the diffraction lines are shifted. The high angle lines

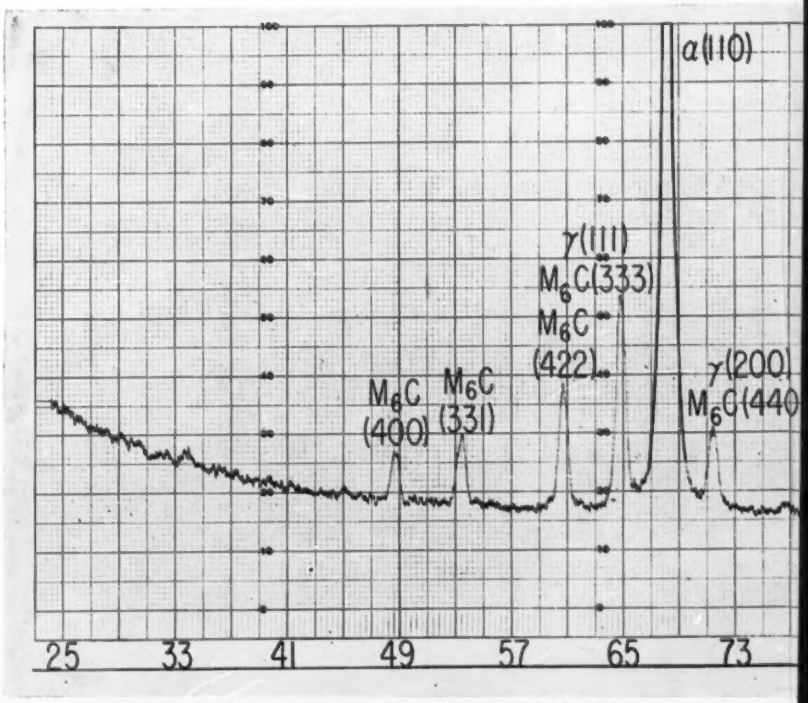


Figure 5—Diffraction Pattern of an as Quenched 18-4-1 Tool Steel.

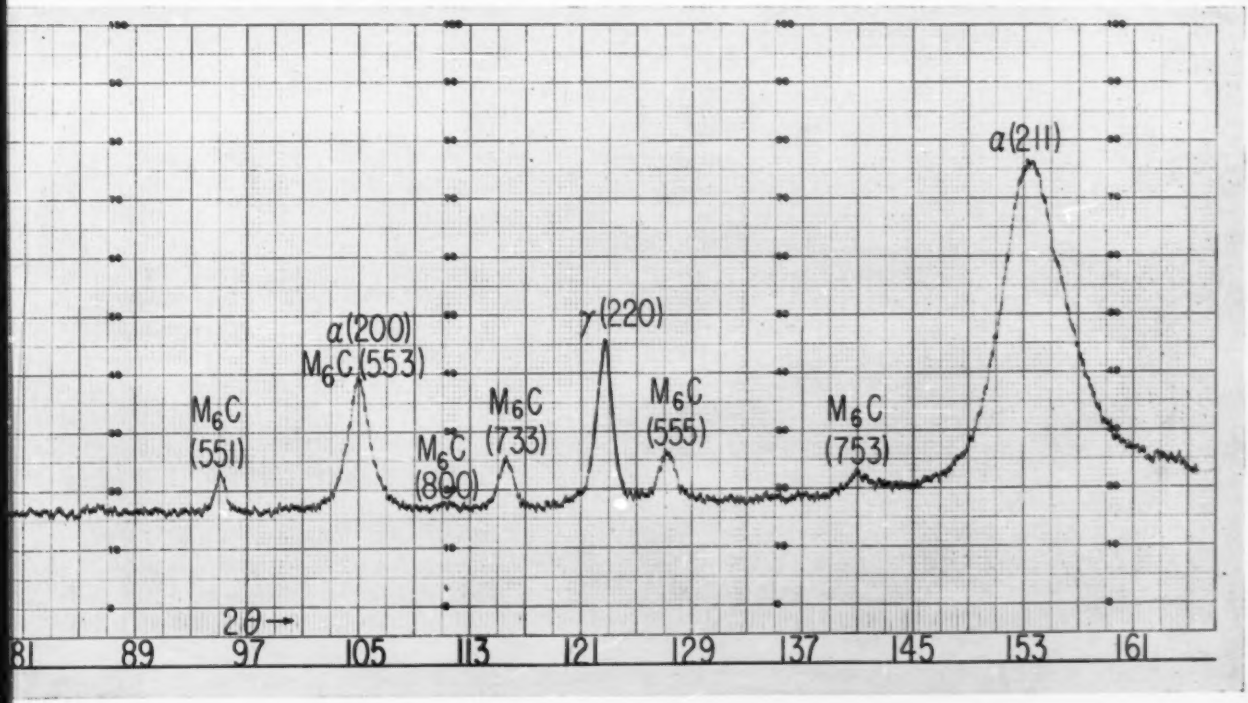
Figure 4—Two of the Commercial Diffraction Units (a) Norelco, (b) General Electric.

are more sensitive to a given strain as is seen by differentiating Bragg's Law:

$$\triangle \theta = - \frac{\triangle d}{d} \tan \theta$$

that is, for a given lattice strain the greater will be the shift ($\triangle \theta$) of the diffraction line the larger the θ value. By selecting a high angle line and measuring the spacing of the planes parallel with the surface of the specimen and the spacing of the planes at an angle ψ from the surface, it is then possible to calculate the stress acting in the surface of the material.

This outline by no means covers the possible applications of x-rays to metallurgical problems. It does, however, illustrate a few important aspects that are being applied in the industrial field today. ■ ■ ■



HEAT TREATING AIRCRAFT FASTENERS

By **THOMAS A. DICKINSON**
West Coast Reporter

BY MEANS of a new dual heat treating setup, Cooper Precision Products of Los Angeles is hardening and tempering threaded fasteners for aircraft in such a manner that the parts undergo negligible dimensional changes and require a minimum amount of cleaning prior to electro-plating.

The setup is said to be "dual" because it essentially comprises two complete heat treating lines—each having its own hardening and tempering furnaces with built-in quench units and an endothermic generator, all of the Ipsen make. As indicated by an accompanying diagram, the only common components of both lines are two washer units.

Duplicate heat treating facilities make it possible for the company to maintain some production in the event of a breakdown. That is an important item, because purchasing agents in the aircraft industry have a marked tendency to favor vendors who can make on-schedule deliveries with optimum consistency.

In addition to eliminating scale and minimizing dimensional changes in parts, controlled atmosphere hardening and tempering furnaces in the dual setup have the advantage of being operatable on a semi-automatic basis—which necessitates the use of labor for the sole purpose of loading and unloading furnaces before and after respective hardening and tempering operations.

The Tocco induction heater shown here is used to produce forging temperatures in bar stock, used in making some of Cooper's largest fasteners.

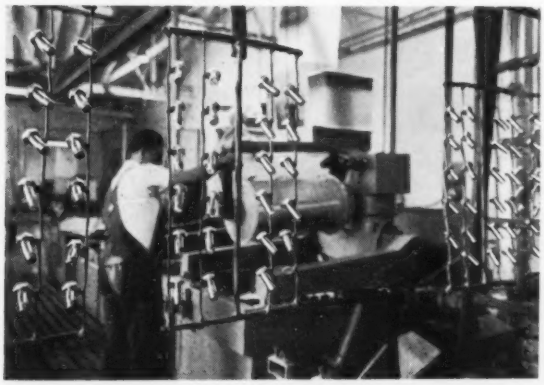
Fasteners to be heat treated are manually loaded in controlled atmosphere furnaces.

The carburization or decarburization of metal surfaces is avoided in operating the furnaces by keeping the generator gas in balance with the carbon content of parts being treated. This is accomplished by adjusting the gas and air mixture introduced in each endothermic generator so as to regulate the generator dew point. Because most of the steel used by the company is of aircraft quality (4037, 8735, and 8740 types being most prominent), a dew point of 20° F. to 30° F. is commonly used in the hardening furnaces while a dew point of 30° F. to 40° F. is most often maintained in the tempering furnaces.

Ordinarily, Cooper fasteners are treated in batches weighing about 100 to 200 pounds each. Each batch is loaded in a basket which is specially designed for Ipsen furnaces, and then the basket is manually pushed into the heating end of a hardening furnace. Automatic controls next take over, producing a specified temperature for about an hour and either air cooling or oil quenching the parts as necessary.

The parts are manually removed from the quenching end of the hardening furnace, after which a roller conveyor may be used to facilitate their transfer to a washer unit in which quenching oil can be removed. The washer unit has a sealed tank which gives maximum heating efficiency and a higher solution temperature—simultaneously eliminating fumes and providing radiation for better drying. Electrical immersion heaters and mechanical agitators permit use of the washer with a high degree of efficiency.

Following an electrically-timed washing interval, accumulations of oil are skimmed from the washer and rollers are used to transfer the basket of parts to a tempering furnace—which is loaded, automatically controlled, and unloaded like a hardening furnace. For a bright finish, a protective atmosphere is used above 400° F.

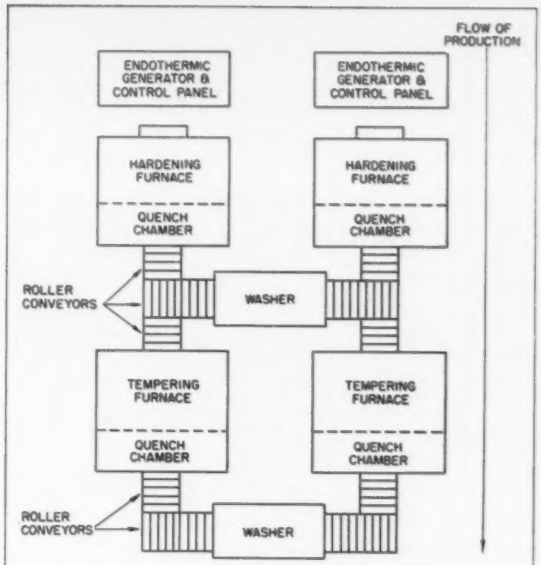


Following controlled atmosphere heat treatments, fasteners can be electroplated without first being pickled.

As soon as they are adequately tempered, the parts are rapidly cooled in the furnace's integral quench tank—which, of course, has a protective atmosphere to prevent oxidation. Then the basket carrying the parts is manually removed from the furnace and taken to the second Ipsen washer unit.

Exact duplication of hardening at relatively great depths is thus attained because the transfer period from heating zone to quench is always equal, and because the oil temperature and its rate of flow can be held constant from load to load. No oxidation takes place because parts at elevated temperatures in any of the four furnaces are protected by a controlled, oxygen-free atmosphere (which is obtained with the two 500 cfh endothermic generators).

Prior to the installation of the new dual heat treating setup, tempered fasteners had to be pickled before they could be silver or cadmium plated. Now, because they are scale-free, they may be plated as soon as they are removed from the second Ipsen washer unit.



SCHEMATIC DETAILS OF COOPER PRECISION PRODUCTS' DUAL HEAT TREAT SETUP

It was also necessary at one time to machine critical dimensions on most parts after they were hardened and tempered—all of which tended to minimize the quality of the fasteners. Such post-heating work is now essential in only a few cases where near-zero tolerances must be maintained. ■ ■ ■

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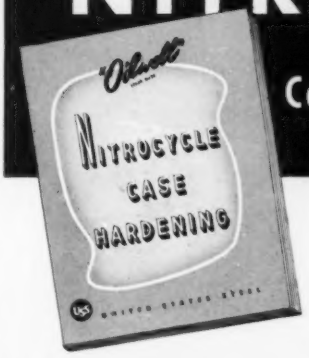

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HARDENABILITY OF TITANIUM ALLOYS

SINCE it has been demonstrated that titanium alloys may be heat treated to high strength levels, the question of the depth of hardening of titanium alloy grades has become of major importance. This is especially true in applications such as airframe forgings, where uniform high strength is desired throughout the section.

To evaluate hardenability, the titanium metallurgist naturally turns to the Jominy end quench test which has proved so useful in the steel industry. However, the Jominy test becomes less clear cut and more difficult to interpret when it is applied to titanium alloys.

The reasons are:

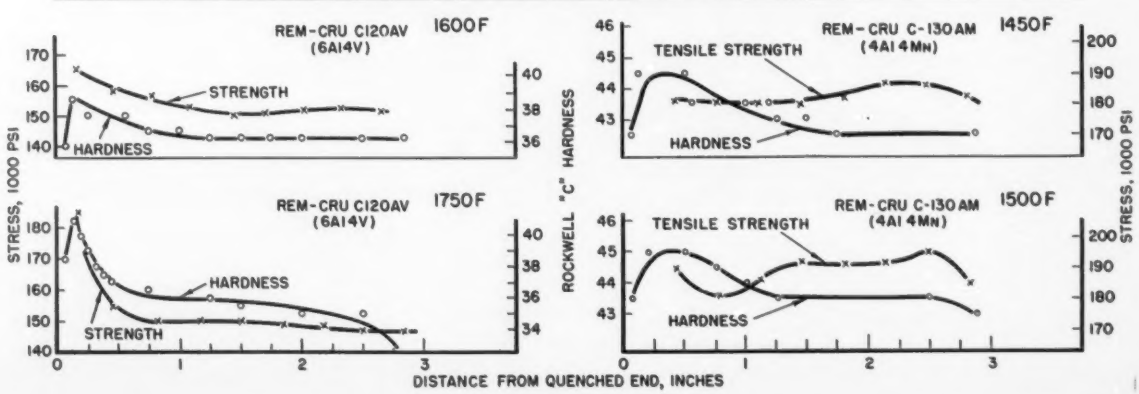
1. Titanium alloys do not quench to full hardness except under unusual circumstances so that an aging treatment after quenching is necessary to obtain useful data from Jominy bars. Considerable work has already been done to establish optimum cycles for mechanical properties, but to evaluate hardenability thoroughly, a rather complete study of quenching temperatures and different aging temperatures and times is desirable.
2. The correlation between hardness and strength in titanium has proved disappointing. In addition to hardness, therefore, microtensile samples cut along the Jominy bars are desirable to provide more precise hardenability data.

Rem-Cru C-130AM (4 aluminum 4 manganese) and C-120AV (6 aluminum 4 vanadium), two alloys which show excellent combinations of strength and ductility in the heat treated condition, were tested in Rem-Cru's laboratories with a series of Jominy bars which were subjected to a variety of quenching temperatures and aging cycles.

The resulting Jominy curves for C-130AM, quenched from 1450 and 1500F, and C-120AV, quenched from 1600 and 1750F, are shown above. These indicate that C-130AM can be hardened in sections up to 6" to a hardness of Rockwell C-42 minimum or a tensile strength of at least 170,000 psi. Rem-Cru C-120AV can also be strengthened to this level, but the hardenability data indicate that this grade is more shallow hardening. This is to be expected in view of the relatively small amount of beta phase available in the latter alloy for effective hardening. How critical the amount of this may be in influencing properties has yet to be determined. Rem-Cru is continuing its study of hardenability to attempt to pin point the effects of quenching temperature, changes in chemistry, and other variables. Meanwhile, the data obtained to date are presented for the preliminary consideration of the design engineer who is interested in the improved properties which can be provided in titanium alloys by simple heat treatments. ■ ■ ■

Source: Rem-Cru Titanium, Inc.

TENSILE STRENGTH & HARDNESS VS DISTANCE FROM QUENCHED END C-120 AV & C-130AM JOMINY SPECIMENS END QUENCHED FROM INDICATED TEMPERATURE & AGED 16 HR @ 900 F



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PROMPT DELIVERY of a reliable product is always desirable. And when delivery and reliability are backed up by both your local dealer and a nationwide service force, your service is *doubly good.*

THIS IS WHAT you get when you order Barrett Brand Anhydrous Ammonia. Not only do you get a product made by America's largest producer of high-purity, extra-dry Ammonia, but you get service from a local distributor.

YOUR LOCAL DISTRIBUTOR is an independent firm whose livelihood depends on his personal service to you, backed by the staff, experience and facilities of Nitrogen Division. He can help you solve any technical problems you may have. He will also provide you with the type of service you want. Call him today!

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For further information circle No. 3

ULTRASONICS FOR THE METAL TREATER

By JOHN STARR

Engineer Research Associates
Los Angeles, Calif.

Since the end of World War II, ultrasonics has probably inspired more really new and practical industrial developments than any other single physical phenomenon. Consequently, it is now being used for such diverse tasks as the detection of hidden flaws in materials, the homogenization of milk, the cleaning of metal parts, the acceleration of chemical reactions, the precipitation of industrial smoke, the precision machining of extremely brittle substances like glass, the treatment of arthritic diseases, and the painless drilling of holes in dental patients' molars.

Yet, despite a number of interesting potentialities, it has thus far found virtually no practical applications in the metal treating field.

Ultrasonics is a generic name for sound waves or mechanical vibrations which are pitched so high that they are inaudible to the human ear. Such sounds have frequencies ranging from about 18,000 to over 5,000,000 cycles per second (whereas audible vibrations have frequencies of about 10 to 18,000 cycles per second), and they may be generated with a number of conventional noisemakers—such as whistles, tuning forks, and sirens. However, most commercial ultrasounds are currently produced with electrostrictive and magnetostrictive transducers.

An electrostrictive transducer is a quartz or equivalent piezo-electric crystal. If properly energized with radio-frequency current, it may produce an ultrasound with any obtainable frequency by rapidly expanding and contracting.

A magnetostrictive transducer is a coil with a ferromagnetic core, which undergoes rapid variations in length when the coil is energized with radio-frequency current. It is not practical for the production of ultrasounds with frequencies of more than 100,000 cycles per second, but is extremely useful where it is necessary to generate low-frequency ultrasonics with optimum power.

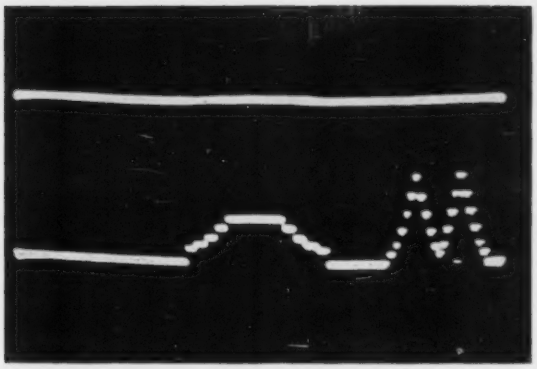
Ultrasound has been a natural phenomenon since the beginning of time. For example, the lowly bat —with his notoriously poor eyesight—has long been an unerring aerial navigator because he is able to send out high-pitched squeaks and identify obstacles to flight by listening to the echoes that return to his ears.

However, the most advanced human scientists were unaware of the existence of ultrasonics until about a century ago; and ultrasound was generally regarded as nothing more than a laboratory curiosity up to the turn of the present century.

Many practical uses for ultrasound were evolved between 1900 and 1940 (for instance, the first ultrasonic equipment for the detection of submerged enemy submarines was conceived and tested in France during World War I); but, for some curious reason, ultrasonic devices in general failed to capture the imagination of practical men prior to the beginning of World War II.

A metal specimen is contact scanned with one of the older ultrasonic test instruments.

One of the most interesting things about ultrasound —from the metal treater's viewpoint, at any rate—is the fact that it can be used to concentrate heat energy more effectively than any other type of power now being generated by mankind. Norman Barnes of



Cross-sectional views of materials, such as the one shown here, are now being obtained with ultrasonic test instruments. The longest white line represents the upper surface of a part. Other lines and dots show where echoes were produced by lower surfaces and flaws within the part.

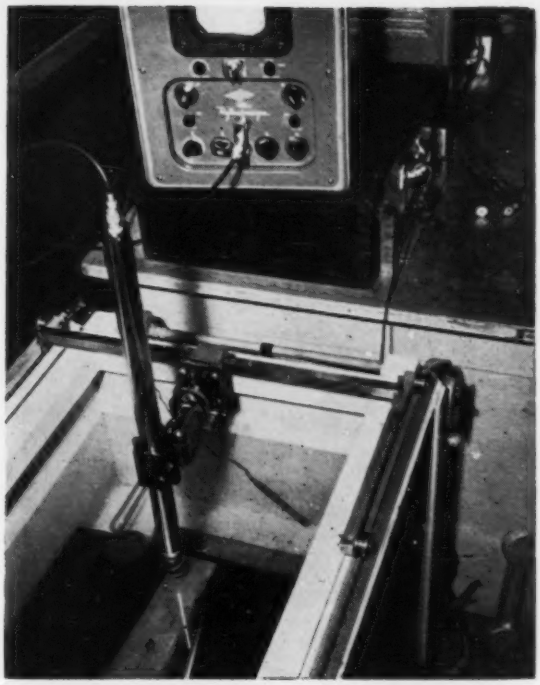
General Electric Company emphasized this point at a recent meeting of the American Institute of Chemical Engineers by stating that it is possible to concentrate a kilowatt (or almost one horsepower) of ultrasound in an area only one centimeter square—which is about ten times the concentration of power in a white-hot tungsten lamp filament.

In view of limitations on the dimensions of ultrasonic transducers which are now available, it seems unlikely that ultrasound could compete with gas and electric furnace facilities where large areas must be heated. However, there is every reason to believe that ultrasonic devices can greatly exceed the performance of gas torches and induction coils where localized heating effects are indicated.

From a general industrial standpoint, ultrasound is probably most important at present where intense agitation is required—as in cleaning metal parts with detergent solutions, accelerating chemical reactions, preparing emulsions with such immiscible fluids as water and oil, etc. In such circumstances, it can be used with almost 100% efficiency because—due to the acoustical properties of materials—little energy can escape from the media being agitated. Even the air above a fluid retainer will reflect energy back into a solution if the latter is being agitated with ultrasonic waves of a proper frequency.

Since their amplitude is such that they can figuratively be described as "accelerations without motion," high-frequency vibrations can agitate a solution much more rapidly than would conventional mechanical movements generated with a relatively large amount of power. Their effectiveness is attributable to the fact that they generate extremely large localized pressures by rapidly forming and fracturing cavitation bubbles—thus expelling the gases that limit the wetting action of fluids.

In the metal treating field, ultrasonic agitators—of the types now being produced by Brush Electronics Company at Cleveland and Massa Laboratories at Hingham, Mass.—should be especially useful in removing scale and other foreign matter from parts with rather small, inaccessible details; also, in reducing time requirements for surface treatments such as anodizing.



A typical immersion scanning setup for ultrasonic testing.

Ultrasonic test instruments have to date found few (if any) applications in metal treating plants. However, thanks to a new development which will be discussed presently, this situation may soon change.

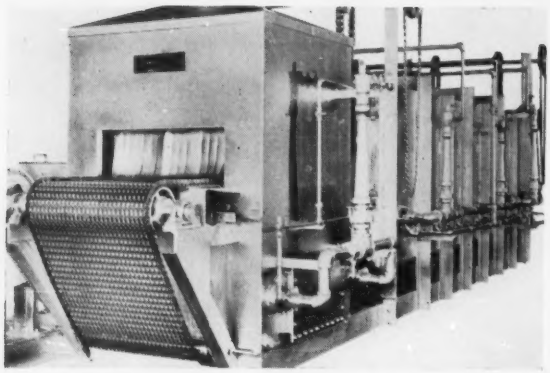
The basic ultrasonic test method at present closely resembles the echo-navigation technique which is employed by bats. First, an ultrasound with the frequency that can most readily be propagated through a test specimen is generated. If no flaws are present, the impulse penetrates the test specimen and is echoed back to its source by a secondary medium such as air or a wood tabletop; otherwise, of course, it is echoed by the gas or foreign matter that comprises the flaw. Then, in any event, the echo is amplified and used to produce a visual signal on the face of a cathode ray tube at a point which is proportional to the distance between the surface of the test specimen and the place where the echo was produced.

As it was initially developed, this procedure was an extremely effective method of locating both large and small flaws deep within materials that could not be tested with X-rays. However, the data obtained did not indicate the size and shape of each flaw; nor did it indicate the existence of defects close to the surface of a test specimen. Moreover, since it was necessary to hold a quartz crystal in close contact with the surfaces of materials being tested, it was impossible to use ultrasound to inspect articles that

IF YOU WERE PLANNING TO DOUBLE OR TRIPLE PRODUCTION WOULD YOU DUPLICATE YOUR PRESENT EQUIPMENT?

Automotive Parts Manufacturer

Installed Third Unit In Same Plant



--- BECAUSE ---

Continuous Direct Fired Annealing Furnace—
Has low cost initial investment factor.
Does a huge amount of work—3,000 pounds per hour.
Requires small hearth area—35 square feet.
Brings work to heat rapidly—shafts weighing 3 lbs. each heat to 1400 degrees F. in 15 minutes.
Utilizes open construction of Industrial Heating Equipment "U" Link Type Belt to heat entire piece evenly.
Operates economically — maximum fuel consumption is 2,000 C.F.H. of 1000 BTU gas.
Reduces parts to desired temperature instantly by means of a spray type cooler.

SEND FOR BULLETIN 15 DESCRIBING THIS EQUIPMENT

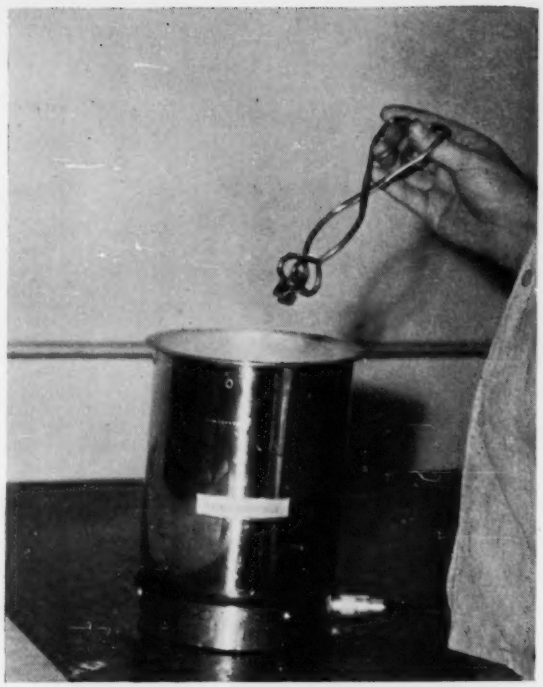
"CIRC-AIR"

INDUSTRIAL HEATING EQUIPMENT COMPANY

3570 FREMONT PLACE

DETROIT 7, MICHIGAN

For further information circle No. 4



A tiny metal part, which could not be satisfactorily cleaned by conventional means, is immersed in a small ultrasonic agitator which contains a standard detergent solution.

lacked relatively smooth and uniform surfaces.

Now these deficiencies have been eliminated. It is possible to test parts with extremely irregular surfaces and to obtain a life-sized or magnified pictorial view of each and every flaw by using an immersion scanning technique that has been developed by ElectroCircuits, Inc., at Pasadena, Calif.

There is no need to bring a piezoelectric crystal in contact with the surfaces of a test specimen because both the specimen and the crystal are immersed in water, which serves as an ultrasonic conductor. Some energy is reflected when ultrasound, thus projected, first comes in contact with the upper surface of a test specimen; but that merely provides a pictorial reference line, which indicates the relative position of the upper surface on the face of a cathode ray tube.

Further, because the water-immersed crystal can be rapidly moved back and forth over a test specimen, a complete cross-sectional view of the material (rather than a graphic indication of each internal flaw) can be obtained.

Extremely fine details regarding such things as the surface grain in a hardened steel part can be visualized —not only because echoes obtained in scanning limited areas can be magnified, but because the output of the piezoelectric crystal is frequency-modulated so that it can simultaneously send and receive ultrasound. Older ultrasonic test instruments could not produce the same details because they had to send and receive impulses and echoes alternately—at a rate of no more than a thousand impulses per second. ■ ■ ■

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corp. Export Distributor: Bethlehem Steel Export Corp.

Want Fast Tool Steel Service?

SEE YOUR BETHLEHEM DISTRIBUTOR

Whether you want to order a quantity of tool steel, or merely a short bar, or just would like a bit of advice about the correct method of heat-treatment, you're sure to find your Bethlehem tool steel distributor anxious to be of service.

Prompt service is your distributor's middle name. He makes it a point to know your city like a book—its background, its people, its industry. He knows what grades of steel you are most likely to need, and in what quantities. And so he keeps large stocks of Bethlehem tool steel on hand, in a virtually endless variety of types, all of them ready to go at a moment's notice.

If you would like bars cut to special length, or if there's a tricky phase of metallurgy or some other tool-steel problem troubling you—again, your distributor is at your beck and call. He's a real friend. They don't come any better. It will pay you to get to know him.

BETHLEHEM STEEL

For further information circle No. 5

Right Or Wrong In

LABOR RELATIONS

Editor's Note: *This department presents, in each issue, a round-up of day to day in-plant problems and how they were handled by management. Each incident is taken from a true-life grievance which went to arbitration. Sources of these cases will be given upon request.*

Are Employees Who Have Been On Layoff For Five Months Entitled To Vacation Pay?

What Happened:

When the company lost a big contract, it began laying off employees. Some of the layoffs lasted from 5 to 7 months. Ten of these employees came back to their jobs in June when the regular vacation season started. When vacation notices went out, these employees did not get their notification. When they complained, the management told them they were not entitled to one because they hadn't worked continuously for a year, having been on layoff for over 5 months. The employees disagreed. They admitted

being on layoff but they didn't lose their status as employees. They still had seniority, they said, and layoff didn't negate any of their rights. We are therefore entitled to our vacation. The Company countered with another "no". In fact, the management argued, "Our policy on vacations supports our position". That policy read: "Each employee who has been in the service of the company *continuously for one year* will receive one week's vacation and when in the service of the Company continuously for 5 years will receive two weeks' vacation with pay". The word "continuously", the company maintains, means "uninterrupted" service and as these men were "interrupted" on a layoff, they are not entitled to vacation.

Was the Company: RIGHT ☐ WRONG ☐

What Arbitrator A. R. Marshall Ruled:

"By the Company's own statement, it has interpreted 'service' to mean continuous work by an employee for one year without layoff being counted. The Company's interpretation would lead to startling consequences. A layoff of one day would mean (technically) that an employee would not get paid vacation for the year. Those in line for two weeks of vacation pay would suffer more because of the five year service requirement. To me, the word 'service' is taken to refer to seniority status rather than to being on the payroll of the Company or its equivalent. After careful consideration of the facts and arguments as presented by the parties, I make the following award:

The workers' grievance is hereby sustained. The recalled employees whose seniority status was maintained during the period of their layoffs are entitled to vacation pay."

If A Plant Is Damaged By Flood, Must Management Pay Employees Who Come To Work But Are Sent Home Because The Jobs Have Been "Washed Out"?

What Happened:

On a rainy Friday night, a flash flood and high winds damaged the factory. For two days, Saturday and Sunday, emergency crews worked through the nights to repair the damage so the plant could be in operation on Monday morning. But to no avail. On Monday morning, 500 employees reported for work and were told to go home and not come back until notified that the plant was ready to operate. The 500 workers, through their Union, filed a grievance for 4 hours "reporting pay" on the grounds that they were not notified not to report for work. The Company's policy on this issue read:

"Employees reporting for work without having been notified by the Company shall be guaranteed a minimum of four hours' work or four hours' pay . . ."

The Company refused on these grounds: 1. This was an act of God and we are therefore not responsible for the situation. 2. We couldn't notify employees anyway because we had no clerical staff available to

(*Continued on page 30*)

FASTER, LOWER COST Hardening FOR ALL Engineering Steels

No Scale . . . No Decarb

Full hardness with no decarburization (even under microscopic examination) of silicon-manganese steel gears is obtained by a machine tool producer in this Ajax salt bath installation.

No other device approaches Ajax neutral salt bath efficiency in hardening steels . . . low carbon, high alloy, stainless, high-carbon high-chrome, high speed types . . . *because only Ajax protects the work so effectively from atmospheric effects.*

All air is "sealed out." A film of salt protects the work up to the instant of quenching . . . keeps the surface clean. Scaling, pitting, carburizing and decarburization are avoided.

LOW COST — First cost of equipment is only ½ to ⅓ that of any other production hardening system!

RAPID HEATING—Heating cycles from 4 to 6 times faster than in radiant type furnaces assure greater production in less time. Distortion is negligible.

UNIFORM RESULTS—*Uniform* physical properties result from *uniform* bath temperatures . . . and, in the Ajax furnace, a temperature variation of less than 5°F is held throughout. Smaller equipment in less space produces a given output. Unskilled labor can handle the entire process.

ADAPTABILITY—Selective heating is easily obtained by immersing only that portion of the work to be hardened. A unique method for hardening gear or sprocket teeth is to spin them in salt, immersing only the teeth.

WRITE FOR Ajax Catalog 116B, also list of documented case histories of hardening installations.

SEND your specimen parts to the Ajax Metallurgical Service Laboratory for treatment. No cost or obligation.

Fast COMPLETELY MECHANIZED HARDENING

4-pound spline shafts loaded 4 shafts to a fixture, and up to 10 fixture loads at a time, are hardened at 1550°F. in a mechanized Ajax salt bath furnace. They are automatically quenched in water followed by a nitrate salt draw at 600°F. The Ajax furnace has operated day in and day out 24 hours a day for over a year without interruption.

5400 BLADES A Day

Good carving knives need exceptionally hard, tough cutting edges . . . and these blades of 440 stainless steel have them! 150 lbs. of work per hour, or 5400 blades per day, are handled in a single Ajax salt bath furnace by one unskilled operator.

MORE WORK IN Less Space

Aircraft landing gears of SAE-4340 steel up to 62" long are hardened in Ajax salt bath furnaces by immersing them vertically in baths 75" deep. Over 800 pounds of work are processed per hour . . . Great space savings afforded by treating pieces vertically. Austenitizing furnace, requires less than 70 square feet of space.

No Rejects

On a run of 30,000 rock bits hardened with Ajax salt bath furnaces, not one was rejected. Bit life was increased 4 to 5 times by comparison with a previous hardening method. Plain carbon steel rather than costly alloy steel is used . . . 480 lbs. an hour are treated in a bath with working dimensions of only 36" x 11" x 36"! Hardness never varies more than 1 point from Rc52.

AJAX electric SALT BATH furnaces

HULTGREN

World's largest manufacturer of electric heat-treating furnaces exclusively

AJAX ELECTRIC COMPANY, 940 Frankford Ave., Philadelphia 23, Pa.

Associate companies: Ajax Electric Furnace Corp.; Ajax Engineering Corp.; Ajax Electrothermic Corp.
In Canada: Canadian General Electric Co. Ltd., Toronto, Ont.

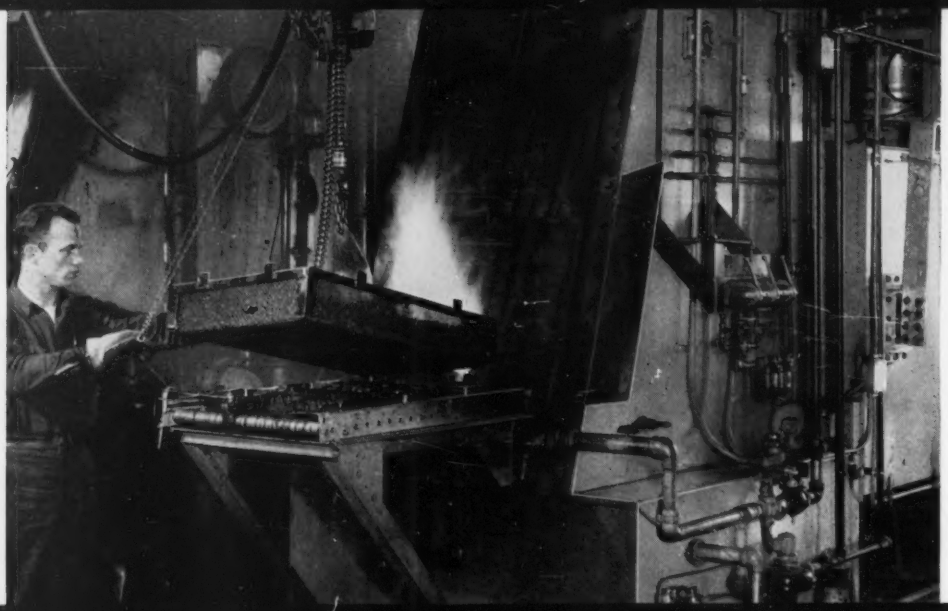
For further information circle No. 6

ALLIED

New Lindberg electric furnace with CORRTHERM element at Allied Metal Treating Corporation, Kenosha, Wisconsin. This furnace is used 24 hours a day, 6 days a week, for carbonitriding, clean hardening pinion gears, hardening crank shafts after carburizing and carburizing small gears and shafts.

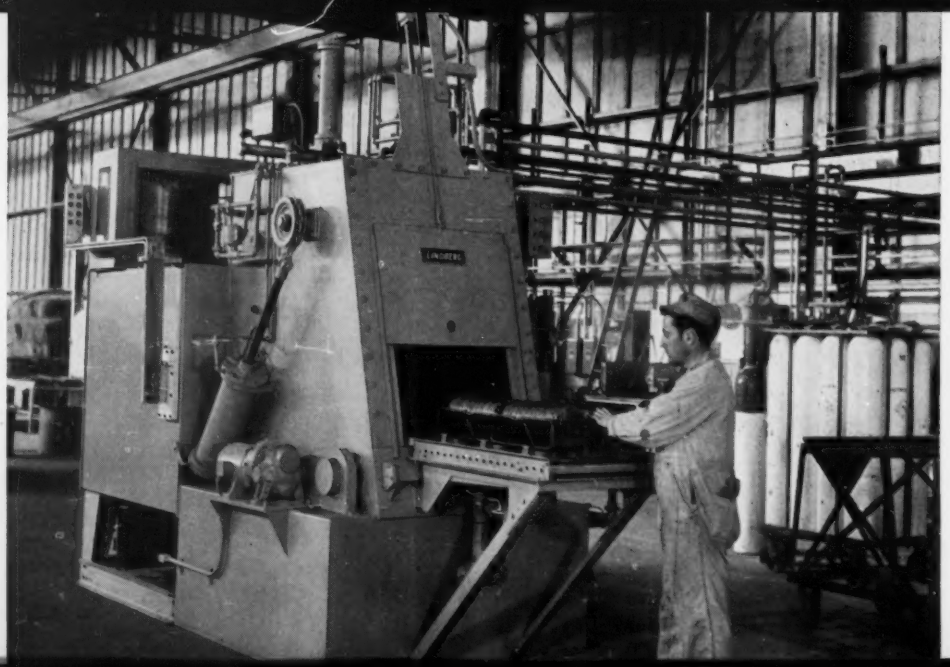
EKLUND

Installation of new Lindberg furnace with CORRTHERM electric element at Eklund Metal Treating, Inc., Rockford, Illinois. Furnace used 24 hours a day, 7 days a week, for carburizing gears and machine tool parts, carbonitriding sheet metal screws and automotive parts, and hardening and tempering bolts.



PERFECTION

Lindberg electric furnace with CORRTHERM element just installed at Perfection Tool & Metal Heat Treating Company's Lombard, Illinois plant. This furnace is being used 24 hours a day, 6 days a week, for carbonitriding and carburizing parts for automotive and farm implement industries.



COMMERCIAL HEAT-TREATERS QUICK TO ADOPT LINDBERG ELECTRIC CARBONITRIDING FURNACES WITH NEW CORRTHERM HEATING ELEMENT

It is significant that commercial heat-treaters, always in the lead in the acceptance and development of better heat-treating methods, have been among the first to appreciate the revolutionary advantages of Lindberg's newly announced CORRTHERM electric heating element.

Recent Lindberg CORRTHERM-equipped furnace installations in plants of three leading midwestern commercial heat-treaters are shown on the opposite page.

Where electricity is the preferred source of heat Lindberg furnaces with CORRTHERM provide to the fullest degree the versatility and dependability required in efficient commercial heat-treating. Ideal for carbonitriding, they are readily applicable to other processes—carburizing, carbon restoration, bright hardening or annealing, and normalizing.

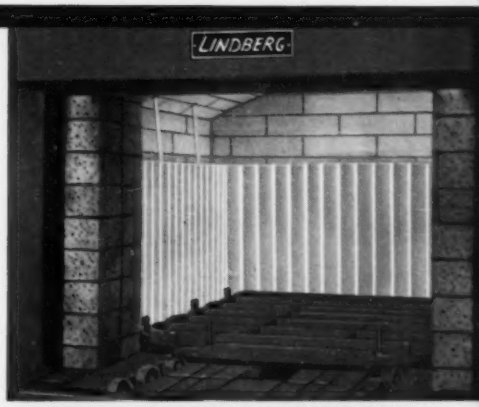
Whether your heat-treating operations are commercial or captive, large or small, the CORRTHERM element in Lindberg electric furnaces offers you these exclusive advantages:

Low voltage—operates at extremely low voltage. No leakage through carbon saturation.

Atmosphere Circulation—elements act as baffle to direct circulation of convection streams.

Safety—extremely low voltage eliminates shock or short hazards.

Durability—watts density at all time low. Element practically indestructible.



This shows how the new Lindberg CORRTHERM electric heating element fills the furnace with walls of glowing heat. Note also that CORRTHERM is conveniently hung from simple brackets requiring no complicated connections or construction.

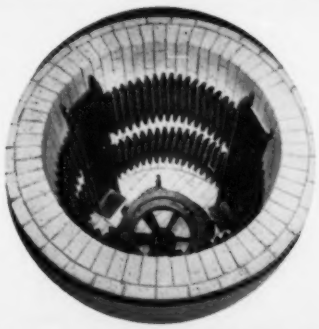
CORRTHERM is an exclusive Lindberg development created in Lindberg laboratories by Lindberg metallurgists and engineers. To find out how its advantages can be applied to your heat-treating processes consult your nearest Lindberg Field Representative. (Look in classified phone book.)

LINDBERG ENGINEERING COMPANY

2466 West Hubbard Street, Chicago 12, Illinois

Los Angeles Plant: 11937 Regentview Ave., at Downey, California

Installation of CORRTHERM elements in one of two large rotary furnaces just erected in the field by Lindberg's associate company, Lindberg Industrial Corporation.



Installation of Lindberg CORRTHERM-equipped carburizing pit-type furnace in plant of Lindberg Steel Treating Co., Melrose Park, Ill.

Safety! Extremely low voltage makes CORRTHERM elements completely safe. Let operator or work load bang it if they will. Neither element nor operator will be hurt.

INSTITUTE NEWS

Apprentice Course

The services of the International Correspondence Schools' Cooperative Training Division and Educational Research Division are available, without obligation, to all member firms contemplating development or revision of training programs, through the Cooperative Training Agreement now in effect with the Metal Treating Institute.

An example of the Scranton, Pennsylvania institution's approach in developing specific courses to meet specific needs is the MTI Heat Treater Apprentice Course, comprised of 29 instruction units in the following sequence of studies as developed some months ago for the Institute. The number following the text title indicates instruction units in the particular phase.

Industrial Economics
Industrial Safety
Elements of Arithmetic
Fractions
Decimals
Weights and Measures
Ratio and Proportion
Powers and Roots
Elementary Chemistry
Geometric Measurements
Formulas
Engineering Mechanics (4)
Properties of Materials
Measuring Instruments (2)
Metallurgy of Iron
Metallurgy of Steel
Metallurgy of Non-Ferrous Metals
Introduction to Heat Treatment
Hardening and Tempering
Heat Treatment of Iron and Steel Castings
Heat Treatment of Iron and Carbon Steels
Heat Treatment for Case Hardening
Heat Treatment of Tools and Dies
Heat Treatment of Non-Ferrous Metals
Foundry Chemistry

A Metal Treating Institute member recently inquired about the minimum educational background necessary for most of the heat treating and metallurgy subjects of the Heat Treater Apprentice Course.

School officials have advised that any ICS course requires at least a sixth grade education and that all courses include all necessary prerequisites to insure that the study material may be fully understood.

There are occasions when an individual who does not have at least a sixth grade education, but who has practical experience over an extended period of time, can successfully complete an ICS course.

If the student has studied elsewhere, or if the firm's training director feels that the employee has sufficient practical experience, prerequisites can be bypassed. In such cases, ICS requires transcripts of subjects studied and grades received from acceptable educational institutions, or a letter or certification from an authorized official of the firm indicating assumption of full responsibility for the prerequisites.

1956 Spring Meeting

The Hotel Roosevelt, New Orleans, Louisiana, has been selected as the site of this year's Annual Spring Meeting of the Metal Treating Institute to be held on April 30, May 1st and 2nd.

A complete program is being planned of sufficient variety so that a balance between technical interests and social enjoyment will be attained.

Official reservation blanks for The Roosevelt and information about New Orleans will be sent to all members within the next month.

Panel Member

Last month, one of the members of the MTI, Fred Heinzelman, Jr., was honored by being selected as a panel member for the technical session of the joint meeting of the New York chapter of the American Society for Metals and the New York chapter of the American Society of Tool Engineers held in the Hotel Victoria. The panel was composed of the following people: Technical Chairman: W. G. Pfaff of Latrobe Steel Co.; and panelists Dr. S. G. Fletcher, Director of Metallurgy at Latrobe Steel Co.; H. U. Erston, Chief Mechanical Engineer at Induction Heating Corp.; and Fred Heinzelman, Jr. of Fred Heinzelman & Sons.

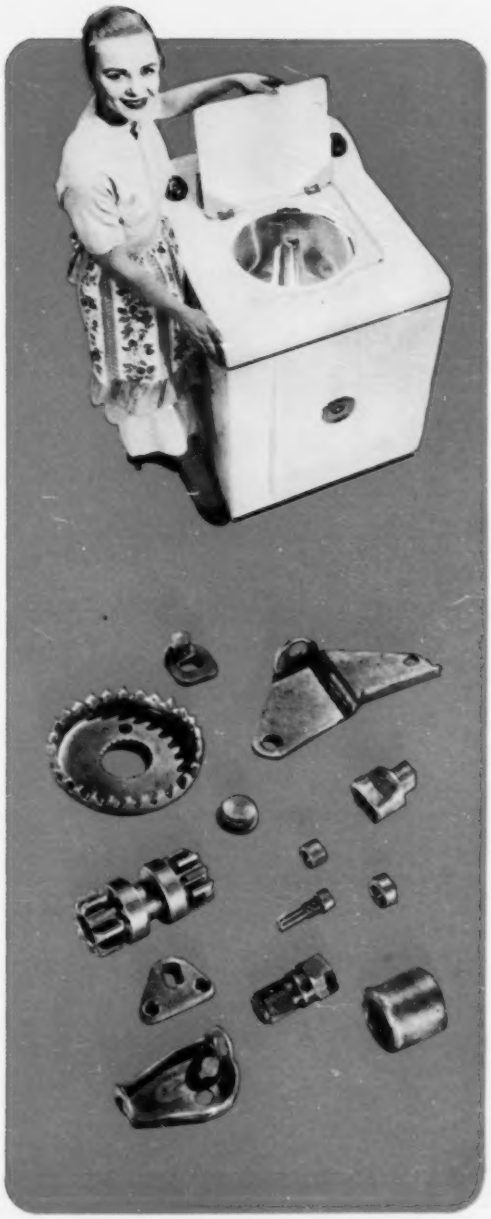
The subject of discussion was the heat treatment of tool steels and the effects of mill practice, tool design and commercial heat treatment upon the finished tool.

(Continued on page 22)

The SPEED QUEEN Story . . .

Carburizing Production Increased with

Park KASE 5-C*



PROBLEM Speed Queen Corp. of Ripon, Wisconsin, planned a 400% increase in the production of Speed Queen Automatic Washers.

More capacity, more production—about 4 times that of before World War II—was the basic problem facing the heat treat department. Most of this increase must be in carburized parts.

Problem two was extremely limited floor space. With the existng building, only 16 x 24 feet of floor space was available for furnaces, controls and quench tanks.

PARTS 22 different washing machine parts. Steel B-1113, C-1213, SAE 1020. Case depths .010-.028" required. One typical part is a B-1113 "double end pinion". Required case depth .028". Others are toggle levers, plates, rollers, etc. Case depths desired are .010" and up. Parts shown at the right.

SOLUTION Speed Queen installed two electric liquid carburizing furnaces containing Park Kase 5-C and one tempering furnace using Park Thermo-Quench Salt. Only 64 square feet of the 224 available was required. Park Kase 5-C at 1650°F produced high quality carburized cases from .010 to .028" as required. Oil quenched parts are cased .028" in 2 hours at 1650°; .010" in 30 minutes. Water soluble Park Kase 5-C permits parts to be easily washed completely clean. Speed Queen reports a complete absence of rejects and reworks as well as much lower costs.

***Park Kase 5-C is a liquid salt bath carburizing compound. It is water soluble, combining ease of cleaning with rapid carburizing rates. PK5-C is equally effective for light case, high dragout work and long cycle, deep casing applications.**

• Liquid and Solid Carburizers • Cyanide, Neutral, and High Speed Steel Salts • Coke • Lead Pot Carbon • Charcoal • No Carb • Carbon Preventer • Quenching and Tempering Oils • Drawing Salts • Metal Cleaners • Kold-Grip Polishing Wheel Cement

Park

PARK CHEMICAL CO.

8074 Military Avenue • Detroit 4, Michigan

Send Free Bulletin Describing Park-Kase 5-C

Name_____ Position_____

Company_____

Address_____

City_____ State_____

Park technical lab has facilities to run samples of your products. We would be glad to suggest a solution to your problems without obligation.

Seventh in a series of advertisements describing Park processes on the Job

For further information circle No. 8

Facilities of...
COMMERCIAL HEAT TREATERS can cut YOUR costs

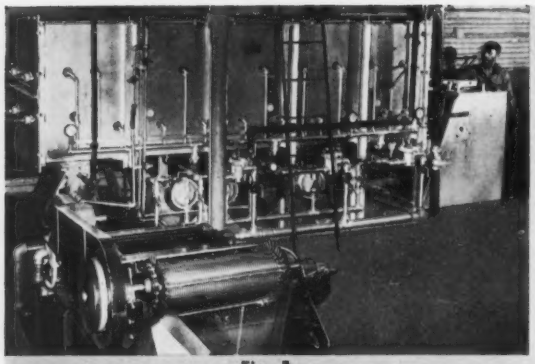


Fig. 1

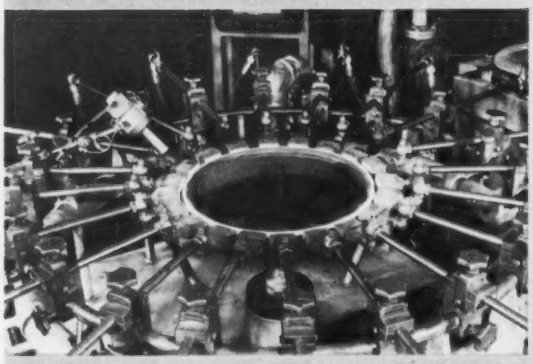


Fig. 2

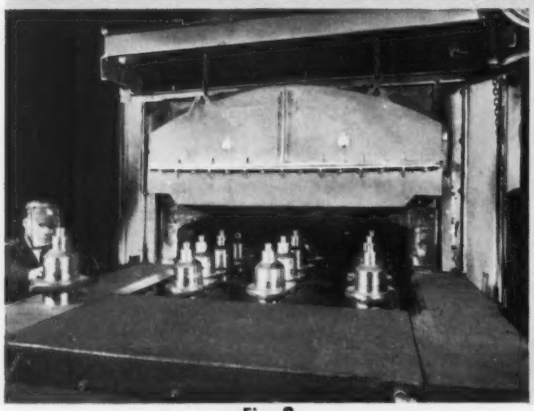


Fig. 3

An MTI commercial heat treater is located near you and is ready to serve your needs by performing "Custom-tailored" heat treating operations.

Because all members of the MTI are specialists with complete service facilities centralized in one plant, they are equipped to offer you a variety of heat treating processes—atmosphere hardening, carburizing, nitriding, annealing, cyaniding, etc.

For example, Fig. 1 shows an installation of a shaker hearth furnace with a continuous automatic quenching tank and a conveyor to a washing machine.

Fig. 2 illustrates a gas flame hardening unit featuring accurate temperature control and using two semi-circular gas manifolds mounted on movable carriages with 20 or more burner heads.

A further example of versatile and dependable equipment found in a commercial heat treating plant is seen in Fig. 3. The specially designed furnace conveyor belt carries over 35 lbs. per sq. ft. in normal service and sometimes as much as 5000 lbs. are loaded on it with pieces ranging from ½ lb. to 100 lbs. and temperatures up to 1650°.

Possessing such equipment together with many other specialized facilities and employing the trained personnel with technical knowledge and experience is the business of the commercial heat treater. Teamwork between him and the manufacturer can cut *your* costs.

Get in touch with the Metal Treating Institute or any MTI member listed on the facing page when you need heat treating services.

WRITE FOR *the MTI booklet called:*
"STRATEGIC USE of OUTSIDE HEAT TREATING FACILITIES CAN CUT COSTS."

METAL T
271 NO

For further inf

Consult any of these HEAT TREATING SPECIALISTS

ALABAMA

outhern Metal Treating Co., Inc.
3131 10th Ave., North, Birmingham 4

CALIFORNIA

ollywood Heat Treating Co.
6902 Santa Monica Blvd., Los Angeles 38
indberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23
alloy Heat Treating Co.
11648 So. Atlantic, Lynwood
ook Induction Heating Co.
4925 East Slauson Ave., Maywood
exter Metal Treating Co.
1026—77th Ave., Oakland 21
ndustrial Steel Treating Co.
1549—32nd St., Oakland 8

COLORADO

etal Treating & Research Co.
4110 Fox St., Denver 16

CONNECTICUT

ommercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
anley P. Rockwell Co.
296 Homestead Ave., Hartford 5

ILLINOIS

enecca Heat Treating Co.
124 S. Batavia Ave., Batavia
ccurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
hicago Steel Treating Co.
333 North California Ave., Chicago 12
ura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
earson Industrial Steel Treating
5757 Ogden Ave., Chicago 50
erfection Tool & Metal Heat Treating Co.
1756 West Hubbard St., Chicago 22
red A. Snow Co.
1942 West Kenzie St., Chicago 22
merican Steel Treating Co.
P. O. Box 225, Crystal Lake
klund Metal Treating, Inc.
721 Beacon St., Loves Park
indberg Steel Treating Co.
1975 No. Ruby St., Melrose Park
. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford
. U. Scott & Son, Inc.
1510 First Ave., Rock Island

MARYLAND

laryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

ew England Metallurgical Corp.
9 Alger St., South Boston 27
orter Forge & Furnace, Inc.
74 Foley St., Somerville 43
reenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Acme Steel Treating Co.
119 Lieb St., Detroit 7
Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

MINNESOTA

Metallurgical, Inc.
900 East Hennepin, Minneapolis 14

MISSOURI

Metallurgical, Inc.
1727 Manchester Ave., Kansas City 8
Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Metal Treating Corp.
611 Grove St., Elizabeth
American Metal Treatment Co.
Highway 25 and LaFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Heat Treating Co., Inc.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark 5
Temperature Processing Inc.
228 River Road, North Arlington
Metro Heat Treat Corp.
9 Victoria Terrace, Ridgefield

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12
Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Metro Heat Treat Corp.
466 Broome St., New York 13
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E., Rochester 5
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
1273 East 55th Street, Cleveland 3
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14
Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16
Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher
J. W. Rex Co.
834 West 3rd St., Lansdale
Drever Company
220 West Cambria St., Philadelphia 33
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 East Mermaid Lane, Philadelphia 18
Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Dominy Heat Treating Corp.
P. O. Box 5054, Dallas
Superior Heat Treating Co., Inc.
P. O. Box 1686, Fort Worth 1
Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11
Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

WISCONSIN

Allied Metal Treating Corp.
830 S. Fifth St., P. O. Box 612, Milwaukee 1
Hushek Metal Processing Co.
1536-40 West Pierce Street, Milwaukee 4
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wesley Steel Treating Co.
1301-1403 West Pierce St., Milwaukee
Harris Metals Treating Co.
1745 Taylor Ave., Racine

CANADA

B. & W. Precision Heat Treating Co.
P. O. Box 544, Kitchener, Ontario

EATING INSTITUTE

MTI MASTER CRAFTSMEN METAL TREATING INSTITUTE

AVENUE • NEW ROCHELLE, N. Y.

or consult the MTI members listed above

n circle No. 9

NO.5 in a series of ALUMICOAT APPLICATIONS

For HIGH TEMPERATURE APPLICATIONS

Alumicoat

Molten Aluminum PROCESS

CAN PROTECT HEAT TREATING EQUIPMENT FROM CORROSION & HEAT OXIDATION!

The new, ALUMICOAT molten aluminum Process has been perfected to give steels added resistance to corrosion and heat oxidation where continuous high temperatures are a problem.

In the ALUMICOAT Process, heat treating fixtures, trays, etc, are dipped in molten aluminum to produce a metallurgical iron-aluminum bond at the interface and a surface overlay of pure aluminum. At temperatures exceeding the melting point of aluminum, the aluminum on the surface diffuses. This diffused coating, together with the iron-aluminum bond, provides a refractory material that gives steel maximum protection against high temperature scaling.

The ALUMICOAT Process can give you greater economies through the use of lighter yet more rugged fixtures with a longer life through added resistance to corrosion and heat oxidation!

Send for full details. Your inquiry is invited.

ARTHUR TICKLE ENGINEERING WORKS, INC.

38 Delevan Street MAin 5-4200 Brooklyn, N. Y.

For further information circle No. 10

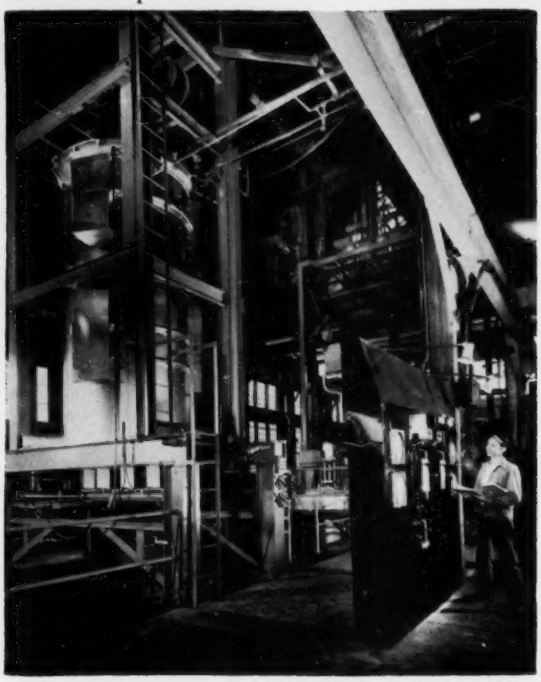
INSTITUTE NEWS

(Continued from page 18)

New Vertical Furnace

Pittsburgh Commerical Heat Treating Co., Pittsburgh, Pa., has recently completed installation of a vertical heat treating furnace capable of handling parts 10 feet, 8 inches long. Furnace chamber is 45 inches in diameter and maximum temperature 1850° F.

An adjacent tempering furnace of the same dimensions is also provided.



The rather unusual design by Elmer Cox, Vice President, combines a stationary furnace beneath which quench tanks (oil or water) are moved and into which heated parts are lowered.

To load the furnace, parts are placed on a movable car and pulled upwards in the retort.

Member Honored

A recent issue of the Chicago *Tribune* contained an interesting article on Leroy A. Lindberg, president of the Lindberg Steel Treating Company with headquarters in Melrose Park, Ill., and branch plants in St. Louis, Mo., Rochester, N. Y., and Los Angeles, Cal. All are members of the MTI.

The article appeared in the famous column written by the financial editor of the *Tribune*, Philip Hampson, entitled "The Road to Success." The article gives an historical sketch of Roy and the company from his early childhood in Beloit, Wis. to the present day in Chicago.

Roy's father was one of the founders of the MTI and was president in 1935. Roy was also president of the Institute, serving in 1946, and is still a very active member. ■ ■ ■

To these well-known benefits you get with HOUGHTON SALTS

• VERSATILITY

Houghton Liquid Salt Baths cover a temperature range of 350° F. to 2400° F. for drawing, martempering, annealing, quenching, carburizing, nitriding, normalizing and hardening of both ferrous and non-ferrous metals.

• FAST HEATING

Since thermal conductivity from salt to metal is exceptionally high, Houghton Salts bring your parts up to heat faster than is possible with other methods.

• PRECISION

Temperatures of modern salt baths can be controlled within two or three degrees. So Houghton's doubly-refined salts give you the same close tolerances you demand in your machine shop . . . batch after batch.

. . . Add Service!

Houghton's research staff works closely with the metalworking industry in servicing salt baths. So a valuable ingredient that is not in the formula goes with every Houghton Salt you buy—the long experience and wide knowledge of your heat treating problems. Ask the Houghton Man for help he'll be glad to give you—or get for you!

Get *"Liquid Salt Baths"* book by writing to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pennsylvania

LIQUID SALT BATHS
. . . products of

E F HOUGHTON & CO.
PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

For further information circle No. 11

PANGBORN
HYDRO-FINISH

For easier handling, for added efficiency . . . look to the new Pangborn Hydro-Finish! Hydro-Finish cleans and finishes molds and dies in minutes, holds fine tolerances. And now it offers many new advantages! Pangborn has done away with the pump; air jet sluriators now keep the abrasive in suspension. This means a lower investment and fewer moving parts. Optional equipment includes a loading stand that simplifies handling, washing and inhibitor application. The cabinet has been redesigned for more efficient operation. These and other advantages make the Pangborn Hydro-Finish ideal for precision cleaning and finishing!

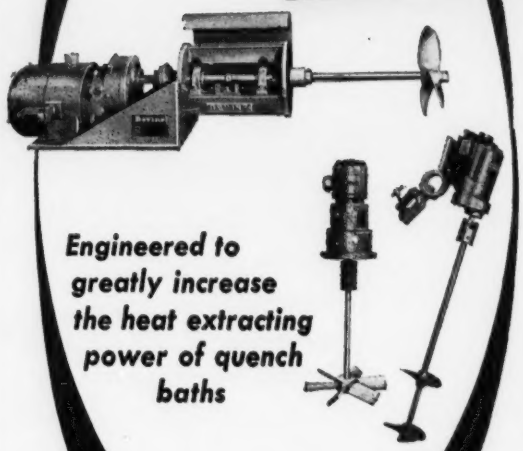
For further details on Hydro-Finish, send for Bulletin 1403 now! Write PANGBORN CORP., 3600 Pangborn Blvd., Hagerstown, Maryland. *Manufacturers of Blast Cleaning and Dust Control Equipment.*

Pangborn

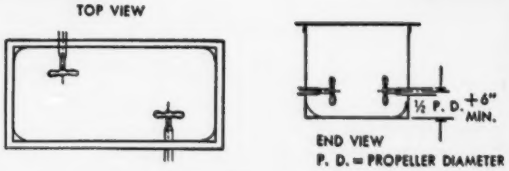
BLAST CLEANS CHEAPER

For further information circle No. 12

Devine Agitators
improve quenching



Engineered to greatly increase the heat extracting power of quench baths



Sketches show a rectangular tank installation. Devine agitators are engineered for specific applications . . . the correct size, number, type and positioning for various tanks, quenchants, etc.

Advantages of Agitation:

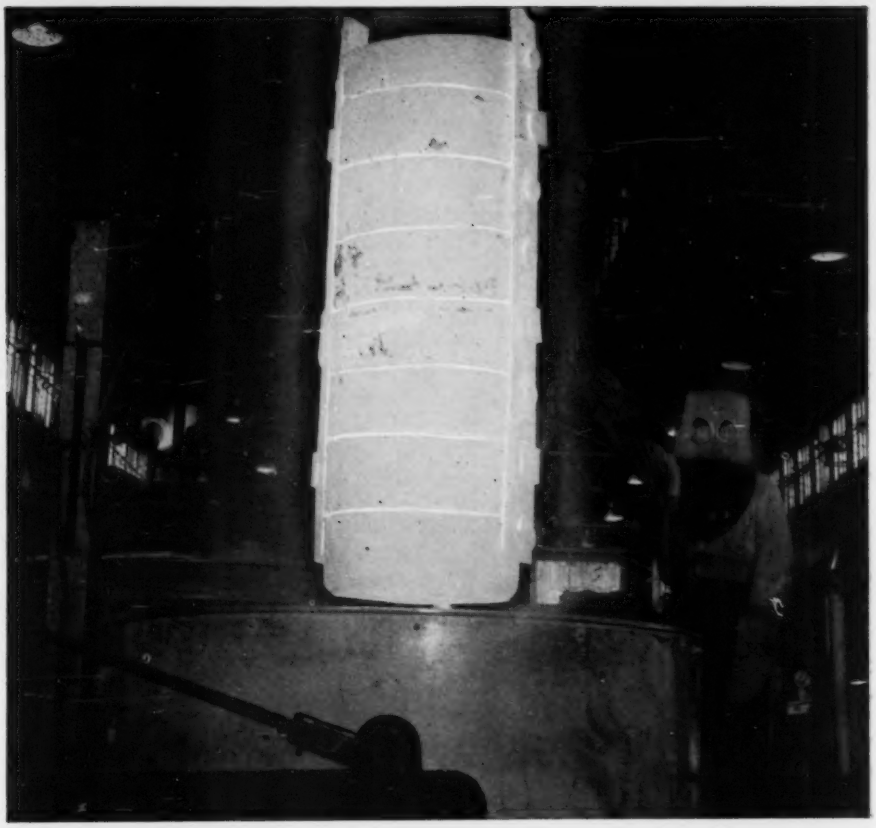
- GREATER UNIFORMITY and DEPTH OF HARDNESS
- FASTER QUENCHING . . . BETTER MACHINABILITY
- REDUCTION or ELIMINATION OF WARPAGE
- MORE SCALE REMOVED . . . Lower Cleaning Costs

Devine agitators are sturdy, compact, self-contained . . . Easy to install, detach and maintain. Consult us about your requirements.

MT-3

J. P. DEVINE MFG. CO.
A. M. Cox, President
49th Street and A.V.R.R. Pittsburgh 1, Pa.

For further information circle No. 13



Removing heat from an Inconel retort at the Bullard Company plant. This is one of six pit type furnaces used to carburize heavy gears used in Bullard Horizontal Boring, Milling and Drilling Machines; Bullard Cut Master vertical Turret Lathes and Bullard Mult-Au-Matic vertical Chucking Machines.

Inconel triples life of pit carburizing retorts at Bullard plant

Averages 12 months' service at 1700°F ...then 6 more when repaired

Is your heat treating equipment lasting as long as it should?

If not, maybe you should try Inconel* nickel-chromium alloy.

Take what happened at the Bullard Company. Retorts up to 84" deep, used to carburize machine tool parts at 1700°F, were failing within six months.

Then Rolock, Inc. came up with a suggestion . . . wrought Inconel. This change in alloys immediately boosted retort life to 12 months. What's more, with this ni-cr alloy, these pots are being repaired by welding, to add an additional 6 months.

*Reg. Trademark

It often works out that way with Inconel. Not only do you get longer life to start with . . . but you also have a high degree of repair ability besides.

There are sound reasons for this. The Inconel pots resist damage by oxidation, carburization and other forms of high temperature attack. This alloy retains its useful properties to 2100° F and over in some applications. It withstands thermal shock. It retains forming and welding properties despite sustained hot service.

So maybe Inconel nickel-chromium alloy is the metal you should try next. Check with your fabricator . . . or write

The International Nickel Co., Inc.
67 Wall Street New York 5, N. Y.

Inconel retort has two lives. On the average, new wrought Inconel retorts fabricated by Rolock, Inc. give Bullard twelve months service. When failure appears imminent, Bullard simply has Rolock weld on a new Inconel bottom to add six or more months extra service.

Inconel... *for long life at high temperatures* INCO TRADE MARK **Nickel Alloys**

For further information circle No. 14

NEWS TO HEAT TREATERS...

HEAT TREATING EQUIPMENT MANUFACTURERS HAVE BANNER YEAR

By CARL L. IPSEN

Executive Vice President
Industrial Heating Equipment Association

Last year's business was the best ever for makers of industrial heating equipment. Orders received in 1955 by members of the Industrial Heating Equipment Association totaled 195% of business for 1954.

On the basis of a survey taken among association members, prospects look almost as good for 1956. Executives of companies making heat treating equipment, after carefully considering projected business conditions, estimate that they will do 88.5% of the business next year that they did in '55. If that sounds pessimistic, it's not. It amounts to 171% of the business in 1954, which was itself a reasonably good year. Of course, industry members are hoping that the estimates will prove to be on the conservative side as they were last year when a survey predicted business would be only 110% of 1954. In searching about for reasons why users of heat treating equipment have been buying in such large numbers, executives of the industry credit the important technical advances made in the recent past.

Of these, several are of special interest to commercial heat treaters. Among these are:

(1) Reduction of distortion by improved martempering and austempering quenching techniques, resulting in fewer rejected parts, and better physical and machining properties.

(2) Closer carbon control, to within a point or a point and a half for carburizing, carbonitriding, carbon restoration, homogeneous carburizing, and for heat treating high carbon steel. With modern control equipment, this can now be done automatically. Closely allied with this is new equipment making for a uniformity of case depth.

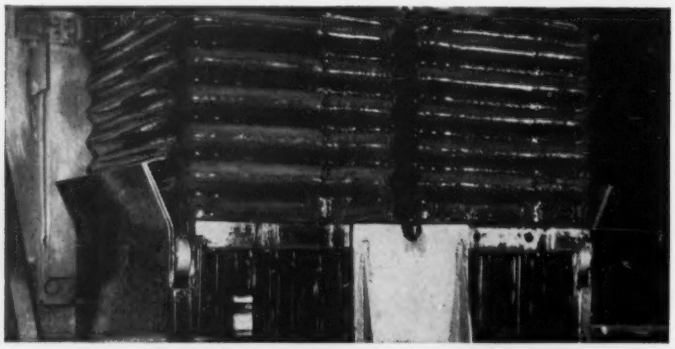
(3) Increasing trend toward automation and mechanization. For example, some new commercial heat treat installations have been installed which work entirely automatically, with *no* operator needed.

Members report a definite trend toward greater mechanization of commercial heat treating equipment, especially in the reduction of manpower in loading furnaces. They also report a larger volume of mechanized equipment in stress relieving and drawing applications.

(4) A new low voltage electric furnace with heating elements that can operate in a carburizing atmosphere, thus eliminating the expensive and troublesome muffle previously required in electric furnaces.

(5) Introduction of vacuum fur-

(Continued on page 28)



Sun Quenching Oil No. 11 lasts four times longer than costly compounded oil

Provides clean, bright-quenched parts at lower cost ... keeps tanks and coolers cleaner longer.

To get clean, bright-quenched parts, J. W. Rex Co., Lansdale, Pa., one of the foremost heat treaters in the country, had to drain their 1500-gallon quench tank every few weeks. High oil cost and frequent shut-downs for tank and cooler cleaning became too expensive.

A Sun representative made a thorough analysis of this problem. He then suggested a switch to Sun Quenching Oil No. 11—at a price about half that of the costly compounded oil they were using.

Now, *twelve months later*, the original charge of Sun Oil is still in the tank! Make-up is considerably lower... parts are continuing to come out clean and bright ...and... tank maintenance costs are practically nil!

To find out how a Sun Quenching Oil can help *you* heat treat metal at lower cost, phone your local Sun representative or write SUN OIL COMPANY, Philadelphia 3, Pa. Dept. MR-1.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT
SUN OIL COMPANY
Philadelphia 3, Pa.

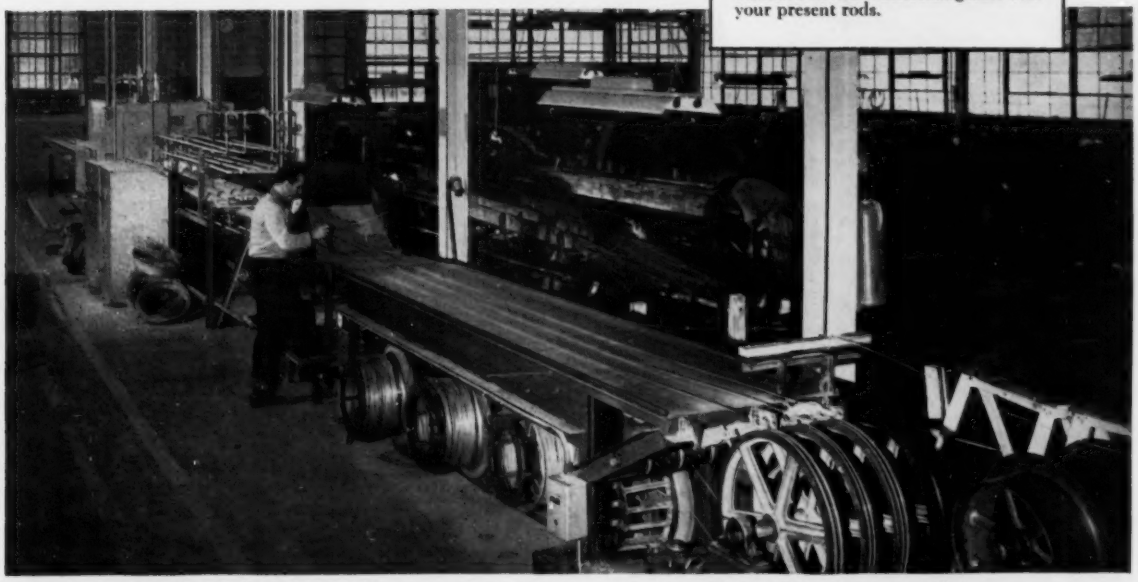
IN CANADA: SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

For further information circle No. 15

Why another plant converted to "HOT RODS" 100%

J. Bishop & Company Platinum Works reports CRYSTOLON* heating elements outlast others by 3-to-1 in Drever furnaces

CRYSTOLON Heating Elements, or "Hot Rods", are a typical Norton Rx — an expertly engineered refractory prescription for greater efficiency and economy in electric furnace and kiln operation. Made of self-bonded silicon carbide, each rod has a central hot zone and cold ends. Aluminum-sprayed tips and metal-impregnated ends minimize resistance and power loss. Available in standard sizes and interchangeable with your present rods.



One of the Three Drever Electric Furnaces at the Frazer, Pa., tube mill of J. Bishop & Company Platinum Works, specialists in small diameter stainless steel tubing (.008" to 1" O.D.), tubular fabricated parts, surgical instruments and refiners of precious metals.

Wherever it uses silicon carbide heating elements — as in its Drever electric furnaces — J. Bishop & Company has changed over completely to "Hot Rods."

The reason: other elements lasted only 6 months — ***"Hot Rods" averaged 18 months' service life!***

More and more, this 3-to-1 longer life of Norton CRYSTOLON elements is becoming recognized for the truly sensational performance that it is — and a constantly growing number of economy-minded electric furnace operators are taking advantage of it.

But there's a good deal more to this benefit-story. The longer life of "Hot Rods" means you save on element costs — because you use less of them. Also, fewer changes of elements and voltage taps mean greatly reduced maintenance, and a much smoother production flow.

Get Further Facts

on how "Hot Rods" can improve and economize your own electric furnace or kiln operations. Send for the big illustrated booklet, "Norton Heating Elements." NORTON COMPANY, Refractories Division, 620 New Bond Street, Worcester 6, Mass.

For further information circle No. 17

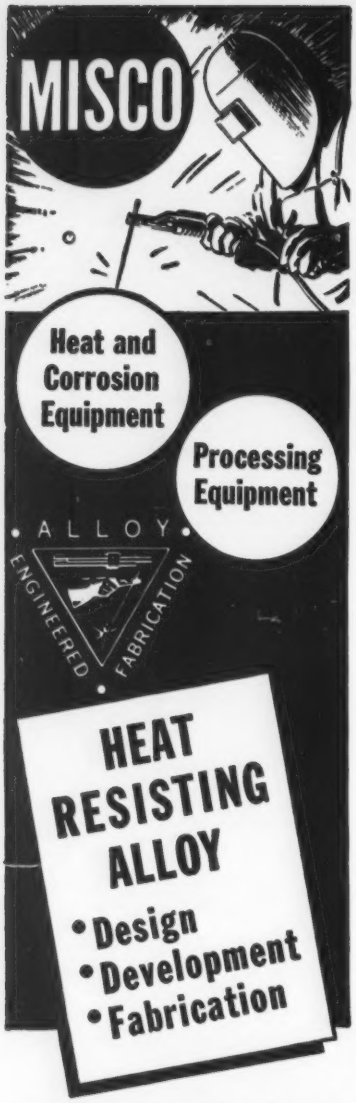
NORTON

REFRACTORIES

Engineered... Rx... Prescribed

Making better products... to make your products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries



BOXES • FIXTURES
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MUFFLES

MISCO EXPERIENCE IS *YOUR* INSURANCE

MISCO FABRICATORS, INC.
Designers, Builders, Fabricators of Heat Resisting Alloy and Stainless Steel Equipment
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TELEPHONE LORAIN 7-1545
In Canada it's Misco Fabricators of Canada, Ltd.
Welland, Ontario

For further information circle No. 18

NEWS TO HEAT TREATERS

(Continued from page 26)

naces for heat treating titanium and titanium alloys.

Translations Available

Aware that much good literature of value and interest to heat treaters is being published abroad, METAL TREATING has made arrangements with a professional translator to advise us regularly of the availability of English translations of outstanding magazine articles, books, texts, etc., that would be of value to heat treaters. We shall publish such a list in this column in each issue.

The following translations are available from Henry Brutcher, P. O. Box 157, Altadena, California; all are illustrated and all have bibliographies. They may be secured by ordering directly from Mr. Brutcher.

No. 3482—*Selection of the Most Favorable Conditions for Porous Chromium Plating;* by G. K. Shvyryaev and M. A. Shluger, translated from *Vestnik Mashinostroeniya,* 1954 ($4.60)

No. 1887—*On Certain Processes Occurring in Steel During Hardening;* by Prof. H. Hanemann, translated from *Hartereitechnische Mitteilungen,* 1942 ($3.80)

No. 3478—*Low-Frequency Heating of Aluminum Billets;* by H Rohn, translated from *Das Aluminium,* 1954 ($6.60)

No. 3030—*Definitions of Heat Treating Processes;* by P. Riebensahm, translated from *Haerterei-Technische Mitteilungen,* 1949 ($5.90)

Dust Control Unit

A special new dust control unit has been developed that removes microscopic solids, fumes and odors from exhaust gases at 99% efficiency. It can be used anywhere impurities are encountered of extremely low and even sub-micron size particles.

Efficiency up to 99% has been obtained in test situations with dust loadings at five grains per cubic foot and 70% of the material below five-micron particle size.

The new unit, known as the Type A Hydro Precipitator Scrubber, is a development of The Johnson-March Corporation, Philadelphia. It collects dust by hydrocompressing exhaust gases through a system of multiple tubes into a water chamber. This produces a highly efficient scrubbing action. The violent water agitation set up causes secondary pressure turbulence and additional scrubbing action in the tube chamber.

The scrubber comes in 15 sizes for capacities ranging between 500 cfm and 40,000 cfm. Sludge can be removed constantly or intermittently by manual, hydraulic or mechanical means.

For further information circle No. 20

Residual Grinding Stresses

A new publication of the Mellon Institute revealing the results of their recent research conducted in connection with the Grinding Wheel Institute and the Abrasive Grain Association is now available free of charge.

The 10-page illustrated booklet is entitled "Residual Grinding Stresses in Hardened Steel", by H. R. Letner, Senior Fellow in the Mellon Institute of Industrial Research in Pittsburgh, Pa.

Residual stresses resulting from surface grinding a hardened ball-bearing-type steel under closely controlled conditions were measured by the deflection method and the effects of wheel grade, unit downfeed, and grinding fluid upon the stresses generated were studied. The stress gradients close to the surface were found to be quite steep and, in a number of instances, both components of the biaxial stress were compressive at the surface. This behavior contrasts with previous dry-grinding experiments on annealed steel and indicates the possibility of generating compressive surface stresses in hardened steel by grinding.

For further information circle No. 21

(Continued on page 34)

7 S&W Furnaces at SPERRY RAND

In the Sperry Electronic Tube Division of SPERRY RAND, Gainesville, Florida, a battery of 7 Sargeant & Wilbur furnaces perform faithfully and economically, aiding in the production of klystron tubes.

● Five S&W Conveyor Furnaces with 15" belts are used for silver and copper brazing of klystron tube components, as well as for degassifying and oxidizing.

Two S&W Pusher Furnaces are used primarily for brazing operations.

Atmosphere is dissociated ammonia, produced from two 2,000 CFH S&W Ammonia Dissociators.

Purging atmosphere is supplied by a 1500 CFH Forming Gas Generator. This atmosphere is dried by an automatic, activated alumina dryer.

Write today for literature—and state your problem. Our staff of engineers is ready to advise without obligation.

Representatives

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Monroe, North Carolina

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Pittsburgh 18, Pa.

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SARGEANT & WILBUR, INC.
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Complete Line of Electric and Fuel Fired Heat Treating Equipment • Furnaces • Generators • Ammonia Dissociators Gas Conditioning Equipment • Accessories

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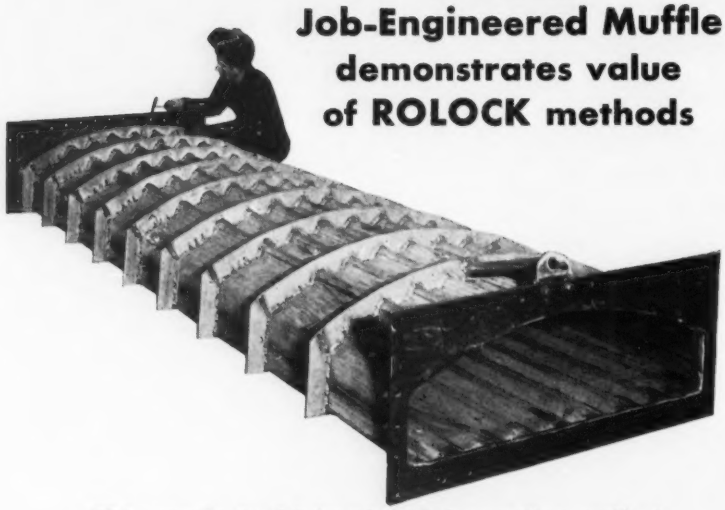
ROLOCK
FABRICATED ALLOYS
HEAT AND CORROSION RESISTANT

2700-lb. Job-Engineered Muffle demonstrates value of ROLOCK methods



This completely fabricated-welded annealing muffle is 13′10″ long, 14″ high inside, and 48″ wide. The material is 5/16″ Inconel. It is used for continuous annealing of copper and brass tubes at 1600°F. in a Rockwell muffle furnace.

The use of homogeneous wrought alloy in an integrated pattern of ribs and corrugations permits relatively thin metal sections for rapid heat recovery and close temperature control with structural strength at tempertaure.

Equipment engineered to the job in close cooperation with the customer and fabricated to Rolock's high quality standards is setting new standards of performance in the heat treating field.

This is just one example from our current production. If you use muffles, furnace retorts, furnace trays or other heat and/or corrosion-resistant equipment, you should know about the services Rolock offers. Write now for our NEW Catalog No. G-10, most comprehensive publication of its kind available.

SALES AND SERVICE REPRESENTATIVES FROM COAST TO COAST

ROLOCK INC., 1232 KINGS HIGHWAY, FAIRFIELD, CONN.

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

8RL55

For further information circle No. 23

LABOR RELATIONS

(Continued from page 14)

send out letters or telegrams. 3. We couldn't phone because the power lines were down in many areas.

The Union wasn't convinced. It counter argued:

There is no "act of God" provision in the contract so the Company cannot claim immunity.

Availability of clerical staffs to notify employees is management's problem.

There are other means of communication available to the Company; namely, radio and television.

Was The Union:

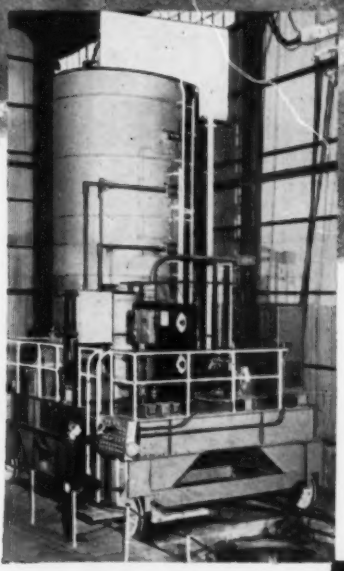
RIGHT ☐ WRONG ☐

What Arbitrator Arthur Lesser, Jr. Ruled:

"I believe that the Company should be relieved of liability in cases of emergency where it is impossible for the Company to notify the people in time not to report when work will not be available. The impossible cannot be expected. If the storm had taken place on Sunday night and the power failure was discovered too late to notify the employees not to report, then I think the Company should not be held responsible for paying for reporting. However, the storm was on the preceding day and by Sunday the Company knew, by vigorously following the situation, that the improbable, having power on Monday, was not going to happen. Therefore, it had time to notify the employees by any means available to it. The Union said, without contradiction, that one particular Company, as well as others, notified employees over the radio and television in spot announcements. This Company could have done the same. The men should get paid." ■ ■ ■

Mother: (speaking to school principal) "My Harold is a very sensitive boy. If the teacher needs to punish him, just tell her to slap the boy in the next seat. This will frighten Harold."

Metallurgical, Inc. chooses Armour Ammonia when heat treating jet plane parts!



With the world's largest commercial vertical drop bottom metal treating furnace, METALLURGICAL, INC. of Minneapolis, Minnesota, heat treats parts of extreme length and diameter.

Bright, scale-free steel parts are hardened to critical tolerances under dissociated ammonia atmosphere provided from Armour Ammonia!

Air Force specifications call for extremely close tolerances and the ultimate in structural strength and durability. Metallurgical, Inc. has found that the dryness and extreme purity (99.98%) of Armour Ammonia is a prime factor in obtaining such results.

More and more companies are using Armour Ammonia for modern metal treating techniques, such as nitriding, carbonitriding and the use of dissociated ammonia in the bright annealing of stainless steel and for furnace brazing. They find the use of dissociated ammonia can cut operating expenditures up to 55% because a single cylinder of Armour Ammonia dissociated yields the equivalent of 34 cylinders of hydrogen!

The Armour Technical Service Department will help answer problems arising with ammonia installations for metal treating. Send today for these free booklets. If your problems are unusual or pressing, write giving full details.

Armour Ammonia is available in 116 cities. Save money on our tank truck delivery service!

CLIP AND MAIL TODAY!

Please send me free booklets which I have checked:

- ☐ "Ammonia Cylinder Installations for Metal Treating"
- ☐ "The Role of Water Vapor and Ammonia in Case Hardening Atmospheres"
- ☐ "Case Hardening of Steel by Nitriding"
- ☐ "A Survey of Industrial Carbonitriding Practice"
- ☐ "Investigation into the Carbonitriding of Plain Carbon Steel"
- ☐ "The Carbonitriding of Alloy Steels"
- ☐ Tank truck service information

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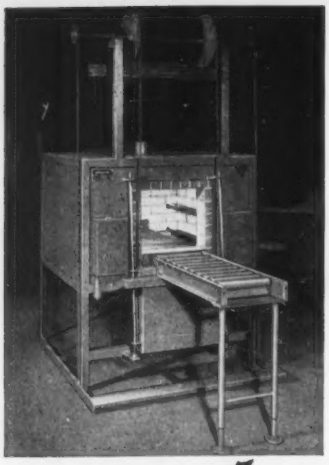
ARMOUR *Ammonia Division*

Armour and Company • 1355 West 31st Street • Chicago 9, Ill.

For further information circle No. 24



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for peak results

MODEL RH-68

Roller Hearth For Heavy Loads

WRITE TODAY

Standard and Special Units 450°F. to 5000°F.

This Model #RH-68 PERECO Electric Roller-Hearth Furnace is especially designed for rapid and easy handling of large or heavy loads, such as tools, dies, or products of similar nature which are difficult to load or unload from a hot furnace. Also ideally suited for enameling metal items. Typical of all Pereco Furnaces built to specialized job requirements. Automatic temperature controls of all standard makes are available to meet the individual need. Tell us your need and let us propose the answer.

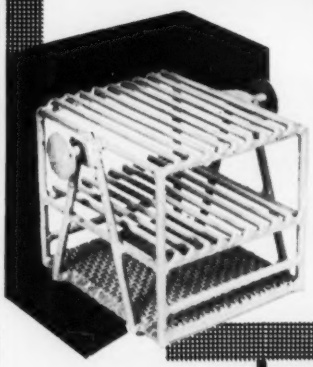
PERENY EQUIPMENT CO.

Dept. O, 893 Chambers Rd., Columbus 12, Ohio

Export Office: Bessemer Bldg., Pittsburgh 22, Pa.

For further information circle No. 25

An Example of **Wiretex Ingenuity**



After 4 months of 24 hour-a-day, 5 days-a-week use, customer found no signs of warping or corrosion. Neither extreme high temperatures nor long hours in the carburizing, molten salt bath, quenching or cleaning applications had any adverse effects.

Call Wiretex

for all your heat treating requirements—to resist acid, heat, abrasion or exposure. Every weave, metal or alloy. Ask for Literature.

Better Design Permits

- Easier loading and unloading.
- Maximum number of parts in a minimum space.
- Largest possible surface area of each part exposed.
- Perfect draining and cleaning.

Wiretex *Specialists in Processing Carriers Since 1932*

mfg. CO. 16 Mason St. Bridgeport 5, Conn.

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Welding Rod
RA 330-80
FOR ARC WELDING
RA 330
35% Ni - 15% Cr - 1¼% Si
HEAT RESISTING ALLOY

Especially developed for use on the high silicon 35% Nickel—15% Chromium RA 330 heat resisting alloy

CRACK-FREE weld deposits without preheat or post-heat

GOOD ARCING and handling characteristics

WELD DEPOSITS free of porosity and slag inclusions

Suitable for welding both cast and wrought alloy. Write or ask for additional information on the RA330-80 electrode.

When you next fabricate a fixture or furnace part, try the new, improved team of RA 330 alloy and RA 330-80 arc rod.

Stocked and distributed exclusively by your heat resisting alloy specialists

SEND FOR OUR MONTHLY STOCK LIST

ROLLED ALLOYS

STOCKED IN			
RA 330	35% Ni–15% Cr–1¼% Si	RA 310	25% Cr–20% Ni
RA 309	25% Cr–12% Ni	RA 430	17% Cr
		RA 446	27% Cr

ROLLED ALLOYS, INC.
Heat and Corrosion Resistant Alloy Specialists
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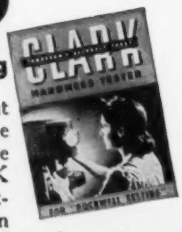
For further information circle No. 26

GET THE FACTS

About Hardness Testing



Everything you need to know about hardness testing is told in this handsome book, prepared by the makers of the internationally respected CLARK Hardness Testers for "Rockwell Testing." Simple, easy-to-read text (in English) and numerous illustrations show the equipment and procedure for fast, accurate hardness testing of ferrous and non-ferrous materials. If you would like a copy, *free of charge*, just attach this ad to your letterhead or write "Send book." A copy will be mailed to you promptly.

P.S. If you are interested in descriptions and prices for CLARK Hardness Testers (Standard and Superficial) of *guaranteed accuracy*, say the word and we'll gladly supply them.

CLARK **CLARK INSTRUMENT INC.**
10203 Ford Road • Dearborn, Mich., U.S.A.

For further information circle No. 28

THE APPRENTICE CORNER

Editor's Note: *The following column appears regularly in METAL TREATING and is designed to aid young men who have only recently started in the heat treating industry. If you would like to see specific subjects discussed, or if you have any questions, let us know what they are.*

Liquid Bath Case Hardening

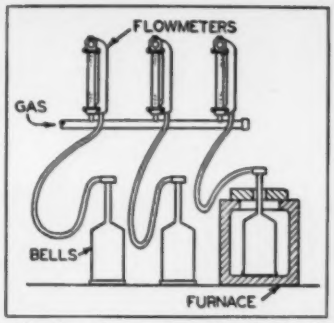
One of the methods employed to impart a hardened surface to low carbon steels is immersion of the part in a molten salt bath. These salts are all dependent upon a cyanide as the active agent. This fact was known to early heat treaters, but the technique of case hardening by immersion in molten salt was not very commonplace. Instead the part was heated and the cyanide was applied to the work and left to melt prior to quenching the heated part in water. Increasing production introduced molten baths as a more practical and economical procedure.

The case hardening salts are essentially sodium and potassium cyanide compounds mixed with various amounts of simple chloride and carbonate salts. Baths of this type are still in use today primarily for the production of light case depths. The composition of the case produced is relatively high in nitrogen and low in carbon as compared to the newer molten bath carburizing salts. Reliable results are obtained if the cyanide content of the baths is maintained at approximately 20%. If the cyanogen content of the bath is too low, the bath tends to decarburize and cause scaling of the work. Drag out of the bath material is replenished by the addition of cyanide salt as needed. It is necessary to keep the strength of the bath constant; if drag out losses of salt are excessive, the addition of 96-98% cyanide may be required.

Temperatures used for cyanide hardening range from 1300°-1550°F. The temperature used depends upon the steel being hardened and the core hardness required. In general, parts are cyanided at temperatures just above the AC3 point because carbon penetration is more rapid and the best mechanical properties are developed in the core when the steel is quenched.

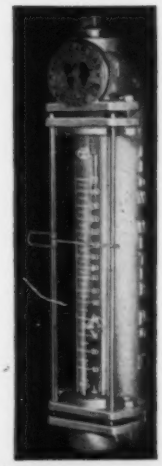
The time cycle varies from a few minutes to approximately one hour. The depth and type of case are controlled by varying the cyanide concentration of the bath, the time at temperature, and the temperature. Low temperature and low concentrations of cyanide produce cases with lower carbon and higher nitrogen content, while high temperature and high concentration produce cases of high carbon and low nitrogen content. The presence of nitrogen in the case imparts greater hardness than is found in surfaces

(Continued on page 37)



The above diagram shows the principle of operation of AGF FLOW METERS.

MEASURE YOUR GAS FLOW TO RETORT OR MUFFLE



AGF FLOW METERS

For Ni-Carbing* and Gas Carburizing in rotary and vertical retort carburizers, these meters permit maintenance and duplication of atmosphere gas flows.

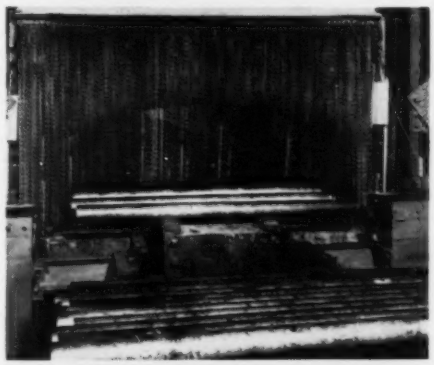
*** The Original Ammonia-Gas Case Hardening Process.**

Made by the PIONEERS in gas furnace equipment.

Write for Bulletin No. 700

AMERICAN GAS FURNACE CO.
808 LAFAYETTE STREET — ELIZABETH 4, N. J.
"Pioneers since 1878"

For further information circle No. 29



Installation of Wiegand Chain Curtain 6½ ft. wide by 3 ft. long in the charging end of a conveyor heat treating furnace. A constant operating temperature of 1650° F is maintained.

HEAT IS MONEY—
SAVE IT WITH

WIEGAND CHAIN CURTAINS

Every heat treater knows that control of heat and efficient use of it is the answer to many basic heat treating problems.
Wiegand Chain Curtains, manufactured by E. J. Codd Co., Baltimore, Md., when used to cover oven or furnace openings wherever solid doors are impractical, result in substantial fuel savings and more uniform furnace temperatures.
Available in sizes to your specifications and for temperatures ranging up to 1750 degrees, these chain curtains have proved themselves in a great variety of furnace and oven installations during the past 40 years.

Write for Our Booklet "Chain Furnace Curtains"

E. J. CODD COMPANY
700-2 South Caroline Street
Baltimore 31, Maryland

For further information circle No. 30

FIRST with mechanized batch-type controlled atmosphere furnaces.

FIRST in uniform work quality. Proved by scores of satisfied users.

FIRST with atmosphere protected quench vestibules.

FIRST and ONLY furnaces with successful *hot oil* quenching systems for clean, distortion controlled parts.

FIRST and ONLY furnaces with successful built-in Endothermic Gas Generators.

DOW continues to give you the finest heat treating equipment with a complete new line of AUTOMATIC batch-type furnaces with ALL the production-proven FIRSTS of the regular DOW furnace line.

FOR COMPLETE INFORMATION - WRITE OR PHONE

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First WITH MECHANIZED, BATCH-TYPE, CONTROLLED ATMOSPHERE FURNACES

For further information circle No. 31

NEWS TO HEAT TREATERS

(Continued from page 28)

Six Annealing Furnaces

Six new elevator-type electric annealing furnaces have been placed in operation at Allis-Chalmers Pittsburgh Works for heat-treating semi-processed transformer core steel.

Each of the 15-ton, 360-kw furnaces heats the steel for several hours around 2000 F temperature in a controlled atmosphere of hydrogen. Coils of core steel are placed in retorts on cars and hoisted into the furnaces. Heating and soaking operations are all instrument-controlled. Upon completion of the treating cycle in the controlled atmosphere, the loaded car is removed and a hood is placed over the steel for careful cooling.

One of the furnaces with its electric control panel, 60-kw saturable core reactors and 230-volt, 900-amp magnetic contactor, along with the 750-kva, Allis-Chalmers dry-type transformer with air interrupter switch is shown in the photo. Each transformer supplies power to two furnaces.

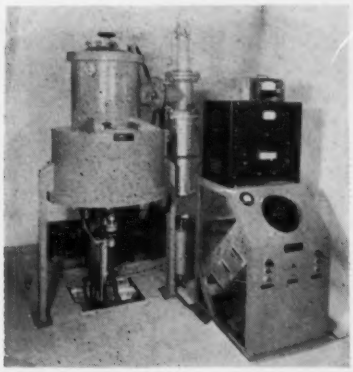
For further information circle No. 32

High Vacuum Production Furnace

A new furnace operating at temperatures up to 2250°C with good element life has been developed by Vacuum Specialties Co. Inc., Somerville, Mass. Higher temperatures, up to about 2700°C, can be reached with reduced element life. The operating pressure can be maintained at less than one micron of mercury absolute.

The upper water-cooled stainless-steel tank holds the heavy wall split-graphite resistance element (six and one-half inches inside

diameter by twelve inches high), expanded carbon insulation and heat shields. A movable heat shield permits observation or pyrometer readings through a sight



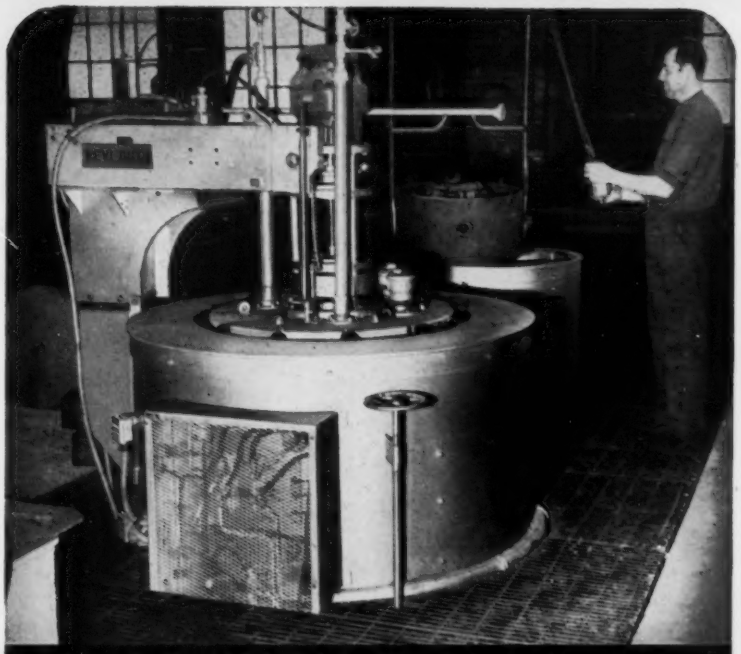
port on the top cover, which is water cooled. The power leads are water cooled and connect to the element in such a way that no hot spots occur.

The bottom water-cooled stainless-steel tank holds a revolving turntable with a six-position indexing mechanism. The work holders (six and one-half inch OD x eleven inches high) sit in recesses around the turntable and are successively raised into the hot element by a water-cooled, insulated pneumatic ram. Thus all six loads can be processed without cooling the element or breaking the vacuum. The furnace is loaded through a port in the top of the bottom tank. The furnace is recommended for all sintering operations and for vacuum treatment of electron tube parts at high temperatures. The design is easily modified to take care of specific production problems.

For further information circle No. 33

Inconel Heat Treating Baskets

Special Inconel heat treating baskets loading smaller than customary machinery parts into the main basket of a nitriding furnace have been designed by the Wiretex Manufacturing Co., Bridgeport, Conn., for the Farrel-Birmingham Co.,



CARBURIZING TIME CUT 4 HOURS with a HEVI DUTY FURNACE

Electrol Inc., manufacturers of hydraulic devices, carburizes landing gear orifice tubes in 3 hours instead of 7 hours formerly required by the pack method.

Edgar B. Roesch, Factory Manager, says, "With this Hevi Duty Retort Furnace, we can produce a more uniform case faster because —

Forced Circulation assures even case depth throughout the densest loads.

Zone Temperature Control helps bring the load up to temperature more quickly and evenly.

Positive Pressure inside the retort has simplified the obtaining of exact carbon concentrations on the surface of the work and to specified depths."

The carburizing atmosphere is supplied from a Hevi Duty Endothermic Generator to which natural gas is added.

This atmosphere protects the work from scaling which results in a further saving of 50% in surface finishing time.

Write for Bulletin HD-646-R and more information about how the Hevi Duty Retort Furnace is used for carburizing, hardening, nitriding, and bright annealing.

HEVI DUTY ELECTRIC COMPANY

MILWAUKEE 1, WISCONSIN

Heat Treating Furnaces... Electric Exclusively

Dry Type Transformers *Constant Current Regulators*

For further information circle No. 34

Inc., manufacturers of heavy machinery. Farrel-Birmingham engineers worked in conjunction with Wiretex to ensure development of a product providing maximum versatility when in use.

The nitriding process at Farrel-Birmingham uses ammonia gas at varying degrees of dissociation and temperatures up to 975° to 1000°F. Cycles for which the baskets have been employed range from 45 hours to 180 hours at temperature.

Baskets are Inconel throughout and 27" in diameter x 12" deep, with frame and braces of ⅝" diameter rod, and lifting hooks and handle of ¾" diameter rod. They are constructed with 2 mesh, 120" Inconel Wire. ■ ■ ■

For further information circle No. 35

FOR SALE

Furnaces & Plating Equipment
Complete - Like New
Immediate Delivery

G.E. ROLLER HEARTH 465 KW, 1650 deg. F, 5' wide, 18" high, 20' long & 40' cooling.
G.E. ROLLER HEARTH gas fired, rad. tube. 5' wide, 18" high, 18' long & 40' cooling.
G.E. PUSHER 240 KW, 1650 deg. F, 4' wide, 12" high, 22' long, quench conveyor.
4000 CFH. EXO GEN. w/each above furn.
YOUNG BROS. GAS RECIRC. CONV. BELT, 1000 deg. F, 6' wide, 24" high, 45' lg. NEW.
500 C.F.H. Westinghouse Endothermic Gen.
SURF. COMB. GAS BOX, 30" wide, 18" high, 36" long, 1800 deg. F.
SURF. COMB. GAS BOX, 4'6" wide, 12' long, 30" high, 1850 deg. F.
2,000 ft. Mechanical Handling System No. 458 Chain with trolley & clevice assemblies.

PAPESCH & KOLSTAD, INC.
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Phone: LIncoln 7-6400

NEW General

FLEXIBLE POWER STRAIGHTENING PRESSES WITH AIR CONTROLLED CLUTCH

- SLASH TIME
- INCREASE PARTS PER HOUR
- MAKE MONEY

General Mfg. Co.
6433 FARNSWORTH
DETROIT 11, Mich.

For further information circle No. 37

WANTED
PRODUCTION SUPERVISOR

Exceptional opportunity for permanent position responsible DIRECTLY TO THE PRESIDENT for man under 40 with good education and experience in mass production especially of medium sized forgings, hardening and finishing, and to set up and operate production control and cost in modern progressing plant with friendly atmosphere. Apply in confidence with full information to:

Ernest Estwing
ESTWING MFG. CO.
Rockford, Illinois

'PSC' RADIANT TUBES in
Any Design or Dimension
Send for PSC Heat-Treat Catalog 54
PSC fabricated tubes furnish four substantial advantages: (1) Light-wall construction saves furnace time and fuel. (2) Return bends are of same wall thickness as tubes, promoting uniform flow of gas. (3) Smooth dense walls minimize carbon build-up and burn-out. (4) Up to 100% longer life. In any alloy, size or type, including parabolics. Also sheet-alloy heat-treating retorts and covers, boxes, baskets, fixtures, tubes, etc.
PSC
THE PRESSED STEEL CO • Wilkes-Barre, Pa.

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CONVEYORIZED FURNACES!
FOR SALE, RENT OR LEASE

Gehnrich Slat Belt Conv. Recirc. Draws, 1000°F
Holcroft Slat Belt GF Recirc. Draw, 35"w x 14"h x 24'l
Industrial Heating GF Mesh Belt, Recirc. 1250°F
Bellevue Continuous Muffle Type GF for 2000°F
Elect. Furnace Mesh Belt Brazing 2100°F with Generator
GE Roller Hearth 858 KW for 1800°F, 60"w x 18"h x 35'l

COMPLETE HEAT TREATING PLANTS, GOOD GOING BUSINESSES IN VARIOUS SECTIONS OF THE COUNTRY. ALL OR PARTS!

Please call "COLLECT" TOwnsend 8-8450

METAL TREATING EQUIPMENT EXCHANGE
9825 Greeley, Detroit 11, Michigan

WANTED

HEAT TREATING FURNACE — Continuous Rotary Retort Hardening Furnace similar to American Gas Furnace 136 or 139. Capacity 150 to 1000 lbs. per hour.

THE MELLOWES CO.
125 E. Nash St. Milwaukee 12, Wis.

LETTERS TO THE EDITOR

Gentlemen:

Our attention has been directed to an article "Subzero Treatments for Metals" in the December issue of METAL TREATING.

We should like to reprint this article in INDUSTRIAL REFRIGERATION, with proper credit, of course, and would greatly appreciate your permission to do so. Also we should like to borrow the four pictures used with the article for having half-tones made.

If we may borrow these pictures and have your permission to use the article as noted above, we shall greatly appreciate your good help.

EDGAR R. CURRY
Managing Editor
Industrial Refrigeration
Chicago, Illinois

Ed.—Delighted to grant permission and to see that our articles are of such calibre and interest.

I am employed by Douglas Aircraft Co., El Segundo, Calif, plant as a metallurgist. Your magazine, METAL TREATING, has been helping me understand a lot of problems connected with my job as well as keeping up with the trends in metallurgy. I would appreciate it very much if you would include me on your list of subscribers.

Thank you.

DAVID R. APODACA
Hawthorne, Calif.

Ed.—This qualified subscriber has been added to the list and we are happy that METAL TREATING is so useful.

Don't boast of being a brave and fearless man until you have felt your way through a dark room at 2 A. M. to investigate a strange noise—and have had a broom handle fall against the middle of your back.

THE APPRENTICE CORNER

(Continued from page 33)

that contain carbon additions only. For this reason some parts are treated at lower heating cycles.

Liquid carburizing baths as distinguished from plain cyanide hardening are used for the production of deep cases of high carbon, low nitrogen content. In composition, these baths differ by the presence of alkaline earth metals (BA, CA, SR) which function as catalysts to increase the rate of absorption of carbon. The operating range of liquid carburizing baths is from 1550°-1750°F. Baths belonging to the accelerated type are operated at 1550°—1650°F. and produce case depths of .030" economically. "Deep Case" baths of more complex compositions can produce case depths up to .090" or more.

Liquid cyaniding and carburizing offer several advantages: close control of case depth; economy and flexibility of operation (several batches of parts may be heat treated simultaneously, each to a different depth); adaptability to mechanization; and simplicity of operation.

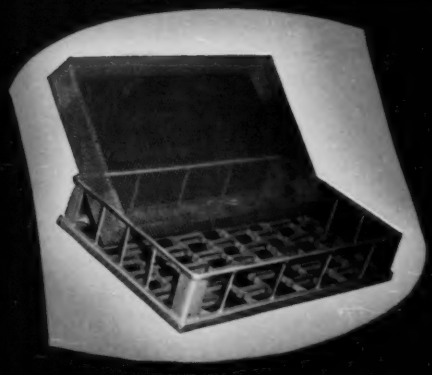
Fred Heinzelman & Sons.

heat and corrosion resistant

CASTINGS & FABRICATIONS

CARBO-NITRIDING TRAY

This General Alloys Company tray, available from stock, is designed for use in the Ipsen T–400 carbo-nitriding furnace. It is a combination of cast and rolled alloy, utilizing the inherent advantages of each, resulting in a lightweight, flexible tray. It has a rugged, semi-tubular outside member to withstand pushing stress and prevent structural deformation. The load is carried in a wire mesh liner and is supported by high-strength cast clips that automatically adjust to the hearth surface and provide a flat, wear-resistant bearing surface. This prevents high localized loads and "digging in" on the hearth surface. This general design also has many other applications.



GENERAL ALLOYS COMPANY
FABRICATED ALLOY DIVISION
403 WEST FIRST STREET • BOSTON 27, MASSACHUSETTS

For further information circle No. 38

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

ROLOCK CATALOG

Rolock Incorporated of Fairfield, Connecticut, announces publication of an entirely new catalog covering in one reference book both heat and corrosion-resistant fabricated alloy products of the Company. With more than 200 illustrations and accompanying descriptions, this is the most comprehensive manual of its kind yet to be published in these fields. Included are sections on Furnace Muffles, Furnace Trays and Fixtures, Retorts and Pit-Type Furnace Equipment, Salt Bath Equipment, Tanks and Sinks, Pickling Equipment, Processing Equipment and Plating Room Equipment.

Of special interest are many unique designs and patented constructions exemplifying advanced technique in welded fabrication of Inconel and other specialized alloys. Illustrations also include a number of massive and complex fabrications in muffles, furnace linings, retorts and tanks representing advances in design engineering and performance.

For further information Circle No. 43

HIGH VACUUM FURNACES

New 8-page catalog describes and illustrates High Vacuum Equipment Corporation's vacuum furnaces for melting, heat treating, sintering, annealing, brazing, degassing, and purification of metals and alloys. It points out that such properties as ductility, fatigue resistance, resilience, temperature resistance, performance life, abrasion resistance, and corrosion resistance can be increased through vacuum melting and vacuum treating.

For further information circle No. 44

HEAT EXCHANGERS

New catalog is now available from Carl Buck & Associates of Essex Fells, N. J. giving complete data on Camac Heat Exchangers for all plating, pickling and anodizing solutions.

Catalog lists all solutions used and proper materials of construction to give satisfactory performance. Included are formulae for determining size of unit needed for any heating or cooling load. Simplified heat loss and steam temperature tables as well as dimensioned sketches facilitate selection of proper unit for controlling temperature in any metal finishing process bath.

For further information circle No. 45

HEAT TREATING LIGHT METALS

A new technical bulletin describing furnaces for the heating and heat treatment of aluminum and other light metal alloys from the ingot to the finished product has just been issued by Surface Combustion Corporation.

It covers all types of furnaces, both batch and continuous, including soaking pits, coil annealers, continuous process roller hearth furnaces, batch type units for heat treating, and melting, as well as investment casting.

For further information circle No. 46

WASTE TREATMENT OF CYANIDES

Processes for treating highly toxic cyanides and chromium compounds in industrial wastes are described in a booklet recently issued by Fischer & Porter Company, Hatboro, Pa.

By means of flow diagrams the 16-page booklet illustrates most common methods of treating cyanide and hexavalent chromium wastes and the applications of instrumentation for controlling the processes. Instruments used are illustrated and described.

The three basic systems for alkaline chlorination of cyanides and sulfonation of chromic acids — batch, continuous, and integrated —are described in detail.

For further information circle No. 47

TITANIUM DATA SHEET

A new 12-page booklet has been recently published by Rem-Cru Titanium, Inc. entitled Rem-Cru Titanium Data Sheet.

The illustrated booklet deals with Rem-Cru C-130 AM, an alpha-beta type titanium-base alloy and discusses its design, applications, physical properties, heat treatability, hardenability and machinability.

For further information circle No. 48

VACUUM MELTED METALS

A new technical bulletin on vacuum melted metals and alloys which includes both general information and technical data was issued recently by Carboloy Department of General Electric Company, Detroit.

The 23-page publication covers the effects of vacuum melting on properties of various metallic materials, benefits of the process to the user of such metals and fabricating and machining recommendations. It also includes detailed engineering data on two new vacuum melted high temperature alloys, M-252 and J-1570, now in commercial production.

For further information circle No. 49

METAL TREATING

EQUIPMENT and MATERIALS DIRECTORY

AGITATORS

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For further information circle No. 39

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For further information circle No. 40

INDEX TO ADVERTISERS AND THEIR ADVERTISING AGENCIES

Advertiser	*Page*
Ajax Electric Company Agency—The Harry P. Bridge Company	15
Allied Chemical and Die Corp. (Nitrogen Division) Agency—G. M. Basford Company	9
American Cyanamid Company (Metal Chemicals Section) Agency—Hazard Advertising Company, Inc.	Outside Back Cover
American Gas Furnace Company Agency—Advent Associates, Inc.	33
Armour & Company (Ammonia Division) Agency—Foote, Cone & Belding	31
Bethlehem Steel Company Agency—Jones & Brakely, Inc.	13
Clark Instrument, Inc. Agency—Whipple & Black Advertising Company	32
Codd, E. J., Company	33
Crucible Steel Company of America Agency—G. M. Basford Company	Inside Back Cover
Devine Mfg. Co., J. P. Agency—William Cohen, Advertising	24
Dow Furnace Company Agency—F. B. Hubert Advertising Counselors	34
General Alloys Company Agency—Robert Hartwell Gabine	37
General Manufacturing Company Agency—F. B. Hubert Advertising Counselors	36
Hevi Duty Electric Company Agency—Camm, Costigan, Inc.	35
Holden Company, The A. F.	Inside Front Cover
Houghton & Co., E. F. Agency—Beaumont, Heller & Sperling, Inc.	23
Industrial Heating Equipment Company	12
International Nickel Company Agency—Marschalk & Pratt	25
Lindberg Engineering Company Agency—Saunders, Shrout & Associates, Inc.	16-17
Metal & Thermit Corporation Agency—RAF Advertising, Inc.	40
Metal Treating Institute	20-21
Misco Fabricators, Inc. Agency—L. Charles Lussier, Inc.	28
Norton Company Agency—James Thomas Chirurg Co.	27
Pangborn Corporation Agency—Vansant, Dugdale & Co.	24
Park Chemical Company Agency—Marvin Hahn, Inc.	19
Pereny Equipment Company Agency—Wheeler, Kight & Gainey, Inc.	32
Pressed Steel Company, The Agency—Wilbur A. Myers	36
Rolled Alloys, Inc. Agency—L. Charles Lussier, Inc.	32
Rolock, Inc. Agency—Robotham & Peck, Inc.	30
Sargeant & Wilbur, Inc. Agency—George T. Metcalf Co.	29
Stanwood Corporation Agency—Tri-State Advertising Co.	40
Sun Oil Company Agency—Ruthrauff & Ryan, Inc.	26
Arthur Tickle Engineering Works Agency—Ritter, Sanford & Price, Inc.	22
United States Steel Corp. (Oil Well Supply Division) Agency—Batten, Barton, Durstine & Osborn	7
Wiretex Manufacturing Company, Inc. Agency—Bass & Company, Inc.	32

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For further information circle No. 42